AUDIO

APRIL, 1963
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AUDIO

APRIL, 1963 Vol. 47, No. 4

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Coming NEXT Month

Construction--

How to build a complete transistorized recording and playback amplifier, including bias/erase oscillator, for a stereo tape recorder.

Measurement--

With the universal use of frequency compensating networks, it is imperative that their performance be measured, both after completion and for maintenance. This article will tell you how.

Musical Instruments--

When the electronic organ is finished, it must be tuned —and occasionally thereafter. Another article telling how, using a 20-cps oscillator, with details for using to accommodate the British and French A's, which differ from ours at times.

And

Equipment Profiles--

The Garrard turntables

The Pilot 285 tuner

The Fisher XP4A loudspeaker

The Knight-Kit KP70 tape recorder amplifier.

In the MAY Issue –

On the newsstands or in your own mailbox

AUDIO CLINIC

Joseph Giovanelli

Send questions to:
Joseph Giovanelli
3420 Newkirk Ave.
Brooklyn 3, N. Y.
Include stamped, self-addressed envelope.

Measurement of IM in Phono Preamplifiers

Q. How do I use an intermodulation distortion analyzer in analyzing the phonograph preamplifier section of a control system? The usual 4:1 ratio of 60 and 6000 cps does not give a proper answer. I use a 1:1 or 1:2 ratio to get a truer value. What is the proper ratio of 60 and 6000 cps to use on the phonograph preamplifier? Dr. J. W. Welch, Wall Lake, Iowa.

A. You are definitely on the right track in your approach to measuring IM in phonograph preamplifiers. What you must take into consideration is that the preamplifier attenuates highs and boosts lows in accordance with the RIAA curve. Hence, comparing the 4:1 ratio with this curve cannot give you valid results.

The following is the method I would use to obtain this measurement. I would feed a 60-cps signal into the amplifier and note the voltage at the output. In so doing, I would be careful not to overload the preamplifier. I would then introduce a 6000-cps tone into the amplifier and measure its output voltage, adjusting the level of this tone until it was equal to that of the 60-cps tone. This would give you a starting ratio. (You would have to measure the input voltages of both tones.) You could then use your 4:1 ratio overlaid on this starting ratio to obtain the results you seek. This approach is as valid as any I know.

"Birdies" and Whistles in Broadcast Receivers

Q. Most AM sets that I have heard are bedeviled by a series of heterodynes, whistles, or "birdies" as the tuning dial is rotated. These, I believe, are caused by the harmonics of the oscillator and harmonics of the i.f. stages beating with stations. I want to build an AM tuner free of this nuisance. Would a tuned r.f. stage or preselector ahead of the converter eliminate this condition? Would a higher i.f., say 1600 kc, get rid of the "birdies"? Any suggestions would be welcome. Bob Conway, Augusta, Georgia.

A. The various "birdies" which you hear on the AM portions of tuners are not generated within the tuners but are generated by local television receivers which radiate considerable energy in the form of harmonics of the horizontal oscillator. There is no way to rid yourself of this kind of interference. There are one or two beats which are the results of mixer beating, but they are not at all serious compared to this outside interference.

Further, the character of the tone produced by these beats is not at all like that of the "birdies" produced by the radiation from television receivers. The tone produced by beats between the local oscillator and image frequency stations is usually a smooth tone; the tone produced by beats between the incoming signal and the harmonics generated by the horizontal oscillator in the TV receiver is a raspy tone, unstable in frequency.

Note the performance of a car radio, It will be free from this interference except when it is in the proximity of a television receiver radiating these harmonics. Note also the similar reaction of a portable receiver.

There are certain rare instances in which these "birdies" are created within the AM receiver. There may be too much local oscillator injection, the tuned circuit or tuned circuits in the front end of the receiver may be misaligned, poorly designed, or defective. This condition will also be present when the receiver is in very close proximity to one or more strong broadcast signals. Under these conditions it is difficult to eliminate the condition. However, it is sometimes possible to increase the amount of a.v.c., which may be helpful.

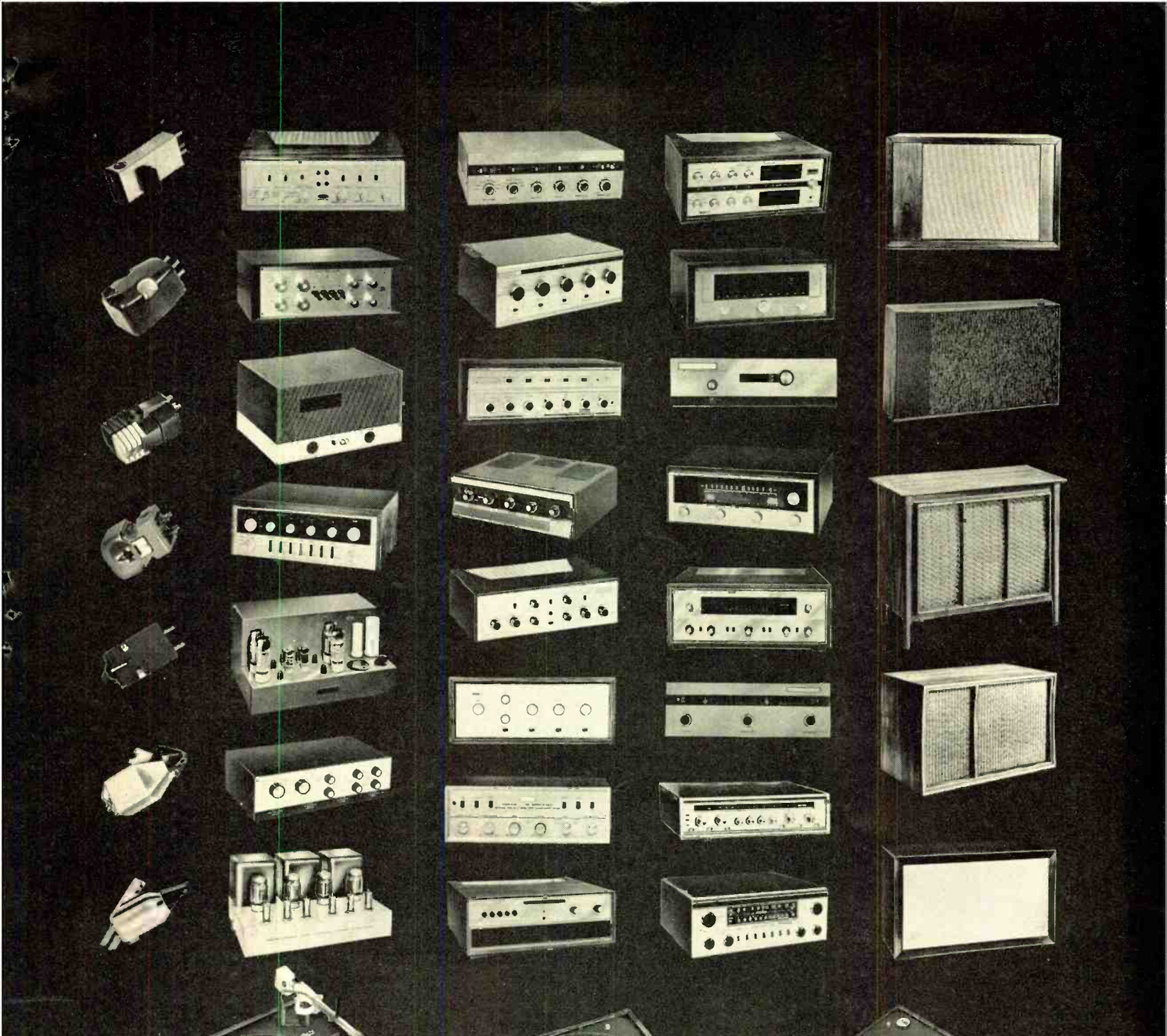
Loud Announcements

Q. I do not know if "Audioclinic" is exactly the right place to discuss my problem. Because my problem is, I hope, of general interest, however, here it is.

The problem arises because of the relative levels of speech and music as transmitted by FM stations. If one adjusts one's volume to obtain a nice listening level, the announcements are unpleasantly loud. I find I use FM consequently, at a somewhat subdued level to avoid the "shouting" announcer. Understand that I am interested in hearing the announcements. I merely wonder if these announcements must approach the level of musical peaks.

I have tried to find out what I could use to alleviate my listening problem. If I understand the use and the operation of speech-music discriminators, they are transient detectors and, therefore, would tend to discriminate against jazz and similar music. I have wracked my brain but I cannot come up with a solution. Is there a way, simple or complex, to attenuate the spoken parts of an FM broadcast automatically? Of course, one could petition all of the FM stations, but perhaps there is a reason for this practice. John De Haven, Minneapolis, Minnesota.

A. Commercial announcements are of great importance in obtaining the money required to operate your favorite stations. If the level of these announcements corresponds to that of relatively soft musical



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passages, these announcements will, in many listening areas, be masked by noise.

Which of these two situations is less objectionable from the listener's seat? It can be argued that if a listener hears these announcements in the noise, he will also hear soft passages in the noise and will not listen to the station in any event. There is also the matter of primary and secondary coverage areas. What coverage is the advertiser paying for? If any reader has observations regarding this subject, make them known to your favorite station and the sponsors of your favorite programs. (*Also, it is against FCC regulations to overmodulate commercials.* ED.) Æ

THIS MONTH'S COVER

This month's cover is intended to break a heretofore unsuspected barrier—and contribute to international relations. Here are the very words of the author:

"It seems rather strange to me that in the past several years, the cover of AUDIO has never shown a music system from Canada. This is not because Canadians don't have fine stereo systems, but perhaps because no one from Canada has submitted a photograph for publication. My present submission may break the barrier. It may also be in the interest of a more favorable U.S.A.-Canada climate to consider my submission since the international weather situation is more than a little chilly at the moment.

"It has taken six years for my stereo system to arrive at its present state. My wife and I debated at length regarding the location of the equipment, since we have six active children who don't always remember that gentleness is required in handling the components. Little by little, the present set-up evolved. First the speakers were put next to the ceiling and the teakwood shelves were added to remove their hanging awkward appearance. The equipment was originally housed in a Barzilay 1709 cabinet; that is, until my youngest son pushed it all over while hunting a toy.

"The following components were used: Electronics are Citation I, II, III; the turntable is a Weathers with P.S.-11 pickup; the speakers are AR-3; the tape player is a Viking 85 RMQ. Miscellaneous items are: Koss headphones, remote speaker switches, turntable clock, external tape recorder connector, Dust Bug, and stereo VU meters.

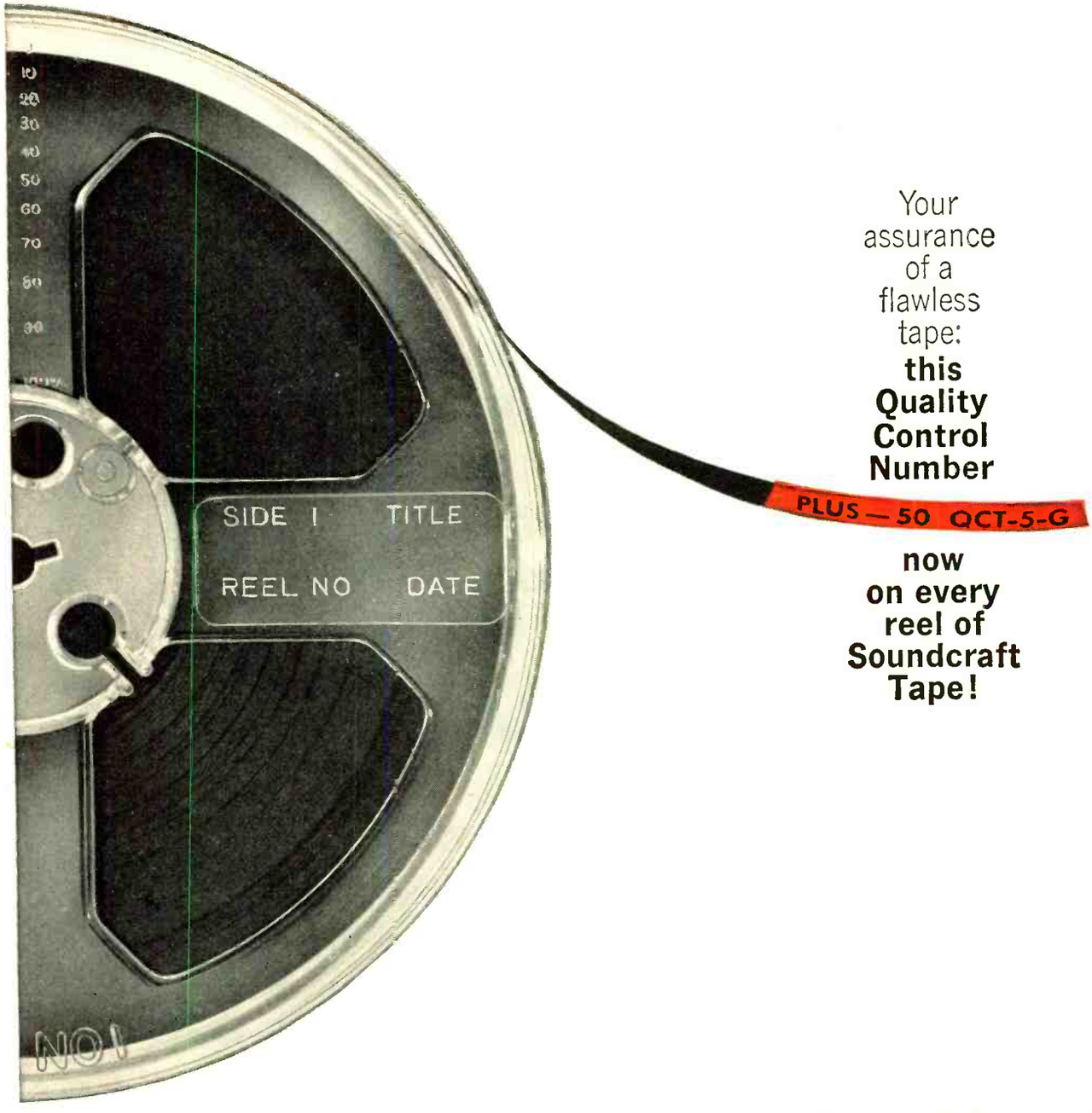
"Tambour doors were used in the teak cabinets and space in the lower portion is reserved for a Viking Stereo Compact. The tape recorder panel swings outward for maintenance purposes, and an access door is located in the opposite room behind the tuner and preamp section.

"FM stereo has not yet come to Ottawa, but with my Finco FM-5 (rotated) yagi on a 20-foot roof-mounted mast, I can reach Toronto (350 mi.), Montreal (150 mi.), and Syracuse, N. Y. (200 mi.) with ease.

"The entire system, including cabinets, was engineered and crafted by Audio Techniques Ltd., Blossom Park, Ontario, and Ed Chatelle took the photograph.

"As a point of interest, I might add that although I work in the Department of Agriculture doing research in atmospheric physics, a great deal of time is spent in musical pursuits. I direct the church choir, my wife and daughters sing in the choir, and I teach music literature at night school.

DR. R. M. HOMES,
Blossom Park P. O.
Ontario, Canada



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LETTERS

He Disagrees with Cooper

SIR:

I disagree with Mr. George Fletcher Cooper's statement that $\mu_f = \frac{\mu}{1-\mu\beta}$ "is not even completely true." ("Series Feedback," AUDIO, December 1962, p. 34).

In fact, this classic equation is rigorously true for a linear feedback network. The problem lies in Mr. Cooper's misunderstanding of the terms used.

μ is not just a simple number but is in fact a complex number completely describing the performance of a *linear* circuit, including its time delays. This complex number is known as the transform of the linear amplifier's impulse response.

Mr. Cooper also makes the statement that "because the amplifier has a limited bandwidth the output lags a little behind the input and does not rise instantly to its final value." is in general confused and incorrect. For example, a simple RC integrator or low-pass filter has a step response which does not reach its full output instantly and yet has no time delay at all in the strict mathematical sense. In short, a limited bandwidth situation does not necessarily mean a time delay situation and vice versa.

Furthermore, an amplifier with a single simple rolloff of 6-db-per-octave within a feedback loop cannot be made unstable, so long as β is a simple fraction, and does not have an oscillatory response as implied by Mr. Cooper's article.

The theory for this argument has been known since the time of Laplace, and is fully developed beyond the state of Mr. Cooper's article. Engineers have only recently been taught the full extent of the theory. Indeed, where it has not been taught, some confusion still exists.

Of course, Mr. Cooper's remarks toward the end of his article concerning large transients *within* the closed feedback loop are correct.

JOHN L. ADDIS
M. I. T.
Box 335, 3 Ames St.,
Cambridge 39, Mass.

Cooper Replies

SIR:

Mr. Addis and I live in different worlds. He lives in an absolutely linear world, in which the proofs of Bode, Chapter 8, are valid. The purpose of the article was to show that stability and linear steady-state behaviour are not enough. The engineering world must live with non-linearities.

I do not know what Mr. Addis means by "delay in a strict mathematical sense.' A low-pass filter used as a delay network, for pulse-forming, for example, gives what I will continue to call a delay. Engineers are usually content to take Brillouin's view of signal velocity discussed, for example, in Stratton, "Electromagnetic Theory," p. 338 (1st Ed., 1941, McGraw Hill). Wiener uses the delay concept in his derivation of a stability criterion. I should be interested to see Mr. Addis' proof that a physical network of finite bandwidth can have zero delay and his way of reconciling this with Bode, Chapter 14.

Of course, a single 6-db-per-octave term will not give an oscillatory response, but a typical amplifier with two wide- and one narrow-band stages will have an amplitude response characterized mainly by the narrow stage. In linear theory it does not matter which order we choose for the tandem connection of these stages. The order becomes important as soon as we accept the fact that our devices are not linear and may be extremely non-linear under some transient conditions.

I do not believe that a theoretical analysis of this problem can be carried through successfully and I am sure it would mean little to most engineers. The statement to which Mr. Addis objects at the beginning was meant to shock so that the reader would continue to the conclusion, with which Mr. Addis agrees. Can Mr. Addis reach this conclusion by his own rigorous standards and present the result in a form which you, Sir, will print and your readers will understand?

GEORGE FLETCHER COOPER

A Method of Measuring Vertical Angle

SIR:

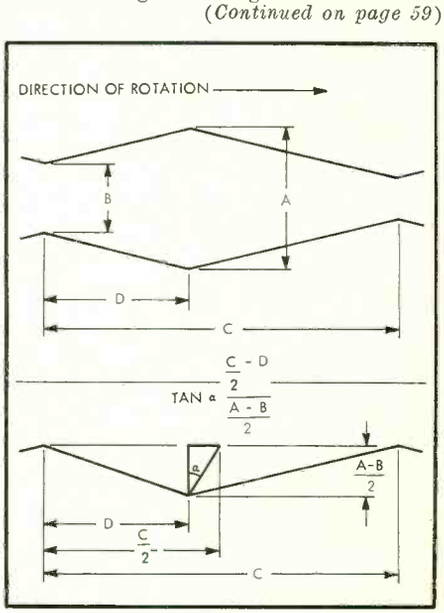
In response to Mr. B. Bauer's statement (AUDIO, February, 1963) concerning the problem of vertical modulation angle in stereo recording, measurements of the actual angle have been made to determine, with reasonable accuracy, the amount by which this angle differs from the recently-accepted standard of 15 deg.

Before any corrective steps could be taken to bring the recording angle of the stereo cutter to an actual 15 deg., a technique of measuring the angle had to be devised. The technique suggested by Mr. Bauer, consisting of measuring the IM distortion by playing back the recording, did not appeal to us because it would introduce too many additional unknowns. As a most logical solution to the problem, optical measurement of the groove shape appealed to us. This turned out to be an accurate method.

To describe the method, it would be appropriate to start with the assumption that all vertical or stereo cutting is done with a 90-deg. stylus. As will be seen from *Fig.* 1 by taking four simple measurements of the groove dimensions, one could calculate the actual vertical modulation angle of the particular stereo cutting mechanism.

Referring to *Fig.* 1, it becomes obvious that knowing the change in width of the

(*Continued on page 59*)



LIGHT LISTENING

Chester Santon

Allan Sherman: My Son, the Folk Singer
Warner Bros. Tape WSTC 1475

Could it be that one of the hidden virtues of tape collecting is the way in which it tends to develop character? If patience is still considered a virtue these days, tape fans certainly have had a chance to develop and display it during the weeks that Allan Sherman's parodies of familiar folk songs became a household fixture in disc form. Those who buy their entertainment on tape are by now reconciled to the fact that best sellers will probably continue to hit their biggest market on discs. The availability of the Sherman album on tape will be good news to those listeners who have banded together to form album "pools." Usually, when a disc makes the round of such a group it comes back to the guy who bought it somewhat the worse for wear. A lending circuit of this type is generally far easier on a tape album. "My Son" happens to be one of those rare comedy releases that will probably make the rounds several times because the humor doesn't evaporate upon first hearing.

Melodies of the Four Winds (Grand Prix Winner, 1962) **Columbia CS 8719**

It would appear that the French pick their top records of the year on a more rational basis than we do. If you've ever puzzled over the reasoning underlying some of the annual awards presented to records in this country, make it a point to hear this particular stereo disc. Columbia Records has perfomued a public service of sorts in making available here the winner of the Grand Prix National du Disque, 1962, for Light Music. It seems to me that any unbiased listener will agree, one third of the way through this record, that the selection of prize-winning records in France is made under a relatively objective procedure. Despite the fact that audio quality did not appear to be uppermost in the minds of the judges, this is a completely captivating disc. Melodies of the Four Winds demonstrates forcefully what can be accomplished when topflight musicians are entrusted with fresh, inventive compositions by thoroughly professional film composers. Marc Lanjean and Roger Roger (yes, Mr. Printer, both names are the same) lead their respective orchestras in this release. Between them, they've managed to corral some of the best players available in Paris when this record was made. If agility and downright zest for playing is any criterion, these musicians more than hold their own with the best men we have to offer on records. In some of the instrumental specialties featuring the string section, their performances would warm the heart of Leroy Anderson. There are several Anderson touches in the course of twelve impressions of music heard around the world. The style, quite naturally, comes closest to Leroy Anderson when Lanjean and Roger describe New York and London. No less inventive and saucy are the deft strokes they use in painting the musical scene in Shanghai, Chile and ancient Venice. A world tour of this type has long been a favorite gambit on the part of arrangers of light music in Europe. What makes this release really different is the way in which these Frenchmen get under the skin of each country they consider. Without lapsing into exaggeration, the French engineering crew provides us with stereo of more than average separation. The amount of auxiliary reverb, although not as pronounced as that of some domestic recordings, indicates that the French playback market is still dominated by the anemic console.

Robert Goulet: Sincerely Yours
Columbia CS 8731

Goulet has traveled a considerable distance as a singing star since his New York debut in Lerner and Loewe's "Camelot" a little over two years ago. If you check back on his work in the original cast "Camelot" album and then listen to this latest release (his third effort as a solo attraction on the Columbia label) you may wonder if this is the same singer who first sprang to fame as Lancelot on the stage of the Majestic Theatre. The difference in style Robert Goulet displays in "Sincerely Yours" can be traced in the main to the nightclub and television appearances he's been making during the past year. His featured songs in Camelot (*C'est Moi* and *If Ever I Would Leave You*) revealed a voice of singular dictinction, far surpassing in clarity, range and color the vocal production of the typical Broadway featured player. A native of Lawrence, Mass., Goulet spent most of his pre-Broadway life in Canada, appearing for three years as the singing star of the Canadian TV program "Startime." His vocal style was free of mannerism when he hit New York ; the voice itself was as fresh as a Canadian breeze.

His current style, while still distinctive and highly commercial in every respect, has become more mechanical, the voice somewhat more metallic after many hours spent projecting his personality in smoke-filled supper clubs. In this latest album, Columbia doesn't improve matters when it subjects Goulet's voice to a longer-than-average interval in the echo chamber. My definition of excessive echo chamber on voice runs something like this : too much reverb is present when the singer's efforts appear isolated in relation to the orchestra. Here the effect is more noticeable than the common occurrence on popular recordings when microphones of widely disparate characteristics are used for vocalist and orchestra. Robert Goulet is not relegated to an "isolation" booth as in some records I've heard but neither is he completely a part of the orchestra's acoustic environment. Goulet's choice of songs, to his credit, is a highly satisfactory one that certainly deserves better sonic treatment than Columbia gives him here. Earlier Lerner and Loewe scores are represented by "Gigi" and *I Talk to the Trees* from "Paint Your Wagon." *Maria* and *Tonight* from "West Side Story" benefit from true theatrical savvy while a few standard tunes such as *Ebb Tide, The Moon Was Yellow* and *The Nearness of You* explain more fully Goulet's conquest of supper club audiences.

Gay Purr-ee (Original Sound Track)
Warner Bros. Tape WSTC 1479

It isn't often that the sound track of a Hollywood animated cartoon forms the basis of a commercial album. Even less frequently is such a recording made available to tape collectors. The thinly disguised title gives some idea of the nature of this musical cartoon : feline adventures in the city of Paris, long a favorite of motion picture producers seeking a locale for a slightly improbable story. "Gay Purr-ee" is a product of UPA, the famous cartoon studio that changed the course of such films with such notable releases as "Gerald McBoing-Boing" and "Mister Magoo." This production is unusual in several respects. The sound track features the voices of famous stars heard in a musical score by a topflight team of song writers. No less a pair of luminaries than Harold Arlen and E. Y. Harburg are responsible for the music and lyrics of "Gay Purr-ee." Supplying the voices for the assortment of cats and kittens seen on the screen is a sizable list of Broadway and Hollywood notables that includes Judy Garland, Robert Goulet, Red Buttons and Hermione Gingold. Without a trace of Disney-ish cuteness or condescension, Judy Garland and Robert Goulet make a fine team as they deliver the main songs in the Arlen score. Miss Garland, portraying the heroine of the film, a naive and provincial kitten named Mewsette, gets the (you guessed it) cream of the songs. *Little Drops of Rain* has a wistful charm that would not have been out of place in the sound track of Arlen's "Wizard of Oz" while *Paris is a Lonely Town* gives Judy the blues mood she handles so well. Robert Goulet, as though to confound those who have heard his latest solo album for Columbia, approaches his songs in a completely straightforward manner, making no attempt to sound like a nightclub attraction. Red Buttons barely gets a chance to strike a glancing blow in the one episode he has in the album. At that, he fares better than Hermione Gingold whose characterization of Mme. Rubens-chatte, the proprietor of a feline beauty salon, appears only in the movie. "Gay Purr-ee" may not shatter any attendance records but it does deserve credit as an offbeat item on which a great deal of work has been lavished.

Dick Dia: The Sound of Magnificent Mandolins
Audio Fidelity AFSD 5963

Jo Basile: Hit Broadway Musicals
Audio Fidelity AFSD 5972

Mandolin virtuoso Dick Dia has been given enough assisting musicians to tackle some pretty ambitious musical fare in his newest Audio Fidelity release. By the time this sixteen-piece orchestra runs through a program of Italian favorites, it finds opportunity to take on one of the best known arias from Georges Bizet's "The Pearl Fisher" as well as a Brazilian samba and the ever-fresh "Never on Sunday" theme. Three guitars, accordion, reeds and percussion provide the variety of instrumental color needed to see one through a mandolin album. With about three-quarters of the stereo listening area taken up by the nine string instruments, Audio Fidelity's ultra-close miking turns out to be a handy device in this album, enabling the rhythm, reeds and percussion to balance the weight of the mandolins.

Jo Basile's accordion tour of Broadway, to no one's surprise, stresses the lighter side of each show tune taken up for consideration. Say one thing for Basile. He doesn't hesitate to plunge his small ensemble into melodic enterprises that would deter other orchestras of this size. He sails into *76 Trombones* with the same spirit of carefree banter found in his treatment of *Bilbao Song, On the Street Where You Live* and *Sound of Music.*

The Temperance Seven
Kapp Stereo Tape KTL 41047

Our own Dixieland style has its advocates overseas in the taped work of this English group dedicated to the preservation of the great songs of the 1920's. The members of the Temperance Seven (approximately nine in uumber) handle their instrumental chores with the deadpan intensity of the pre-talkie movie comedians. A good percentage of the outfit has seen service in a variety of well-known British bands. Despite the fact that most of the members pursue daytime careers in fields unrelated to music, the work of the Temperance Seven betrays no evidence of the well-meaning gawkiness usually associated with groups playing Dixieland for comedy effect. Since their battery of instruments numbers at least sixteen items found on bandstands forty years ago, there is ample variety in their crisp renditions of *Hard-Hearted Hanna, Black Bottom and Everybody Loves My Baby.* A piano and tuba duet during *Falling in Love* seems altogether fitting and proper after some of the solemn vocals by "Whispering" Paul McDowell. The sound on this reel, although faithful to another period, has all the contemporary graces in matters of clean transients and convincing tonal color.

NEW CIRCUITRY, NEW FEATURES, NEW IDEA IN STEREO

"Modern" is not the word. Perhaps "ahead-of-its-time" is a bit more descriptive of the new Altec 708A "Astro." How else would you describe an all-in-one stereo center full of features and facilities never before available in a single package?

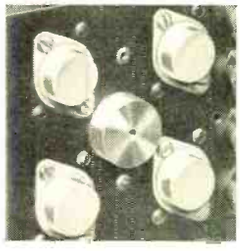
For example, consider its circuitry. Transistors are combined with new frame grid tubes to gain the best qualities of each. As another example, consider its unique stereo headphone facilities. The output receptacle is in the rear; you may leave the headphones plugged in permanently, out of sight when not in use. The headphone switch, however, is located conveniently on the front panel.

Or, consider the unique tape recording monitor that functions much like monitors in professional recording studios. Namely, it permits you to monitor any source material two ways *during* recording: the instant signal enters the record head or directly from tape, the moment it is recorded. And these features are only a sampling. Truly, the "Astro" is "ahead-of-its-time" even down to the smallest details such as the exclusive friction-lock controls that obsolete awkward dual knobs found on conventional stereo equipment.

COOLNESS OF TRANSISTORS— PRECISION OF FRAME GRID TUBES

For cool operation, Altec makes judicious use of transistors. For highest sensitivity and quietest performance imaginable, new ultra-precise frame grid tubes are used. This proper combination of transistors and tubes in the "Astro" has produced results that are just this side of miraculous.

The "Astro" is sensitive, stable and completely consistent in its performance (top-notch!) and utterly free of drift. Indeed, it is the first truly practical stereo center because transistors in the power stage make it run cool for hours on end. Unlike ordinary "hot boxes," the "Astro" secures peak operating efficiency and maximum life from resistors, capacitors, and other subcomponents in its circuitry. And, because it runs cool, the "Astro" is the first practical unit for built-in installations.



55 watts from an area the size of a postcard!

That's the magic of transistors: the four shown at left make up the power stage of the "Astro." In all, 12 transistors and 17 tubes are used in this entirely new stereo center that is rated several years ahead of its time.

WHAT MAJOR COMPONENTS ARE INCLUDED IN THE NEW "ASTRO"?

Five integrated stereo components are packaged in a compact 6″ x 15″ x 13½″ cabinet: FM, FM multiplex, AM, dual-channel preamplifiers, dual-channel power amplifiers. The wide band FM tuner features 1.2 microvolt sensitivity (equivalent to 0.75 microvolts with matched 72 ohm antenna) to assure highest gain, lowest noise. A built-in FM stereo multiplex receiver provides 30 db stereo separation between channels over the entire audio range. To take all guesswork out of tuning, a monitor light goes on automatically when stereo signal is received. The AM tuner provides high sensitivity and excellent image and IF rejection.

The preamplifier section features a complete complement of controls and includes facilities for everything from record and tape player to the stereo headphones. Powerful dual-channel amplifiers deliver 27.5 watts each down to 20 cycles (IHFM standard) with ± 1 db, 20-20,000 cps frequency response.

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Percy Faith: Exotic Strings
Columbia CS 8702

For many years the Columbia catalog of popular music has been built around the talents of two famous conductors—Percy Faith and Andre Kostelanetz. It may come as a surprise to audiophiles who cut their eye teeth on the early Kostelanetz recordings that Percy Faith has surpassed Kosty in the number of LP albums each conductor has listed in the Schwann catalog. The current figures stand at 29 for Faith as opposed to 23 for Kostelanetz. Equally impressive, in my opinion, is the fact that Faith has been allowed to keep his own style while Kosty, during the last year or so, has been pressed into converting his fine organization into a king-size novelty group designed to showcase the gaudier aspects of channel-switching stereo. Another interesting detail of the gradual shift in the position of these two orchestras in the Columbia hierarchy lies in the assignment of manpower. Some of the recent Kostelanetz recording sessions have been employing fewer men than Faith has at his disposal in this album. A large Hollywood studio used for this session surrounds fifty strings welded by Percy Faith into the smooth ensemble that has always been his trademark. The arrangements of great Broadway and Hollywood ballads by Arthur Schwartz, Jerome Kern, Cole Porter and Vincent Youmans are among the most tasteful turned out today. Adding a tart sauce to the solid fare provided here is a Faith original, "Chico Bolero," its plucked strings heard in countermelody against a South American-ish theme. The only jarring element in the album is the application of the usual amount of added reverb found in practically all releases of Columbia's stereo "360 Sound" series.

Mutiny on the Bounty (Original Sound Track)
M-G-M Tape STC 4200

One of the nice things that could be said about this sound track recording is that it does not run for the period of three hours taken by the film. This merciful factor may not be fully realized by the layman who does not have to sit through a succession of sound track recordings on a monthly basis. After all, the number of new ideas that occur to Hollywood composers after so many years of movie scores is really less than earthshaking. Bronislau Kaper, twenty years with Metro-Goldwyn-Mayer, won the assignment to provide music for Marlon Brando's remake of "Mutiny on the Bounty." Kaper's score is spiced with inserts of musical footage recorded in Tahiti. These excerpts of native music are blended by Kaper into long skeins of melody that begin with the sailing of the Bounty from Portsmouth harbor and continue to the death of Fletcher Christian on Pitcairn Island. As sometimes happens on film track releases, the musical sequence in this album has been slightly altered from that of the motion picture in the interest of more diversified listening. The impact of the sound on this four-track tape provides only a modest echo of the wallop packed in the theatre when the original sound track rolls out the full power of the MGM Symphony Orchestra under the direction of Robert Armbruster. Within the framework of the average four tracker's dynamic range and frequency response, this reel offers bounty enough to forestall serious grumbling on the part of any crew of purchasers.

Alfredo Kraus Sings
Montilla FM 177

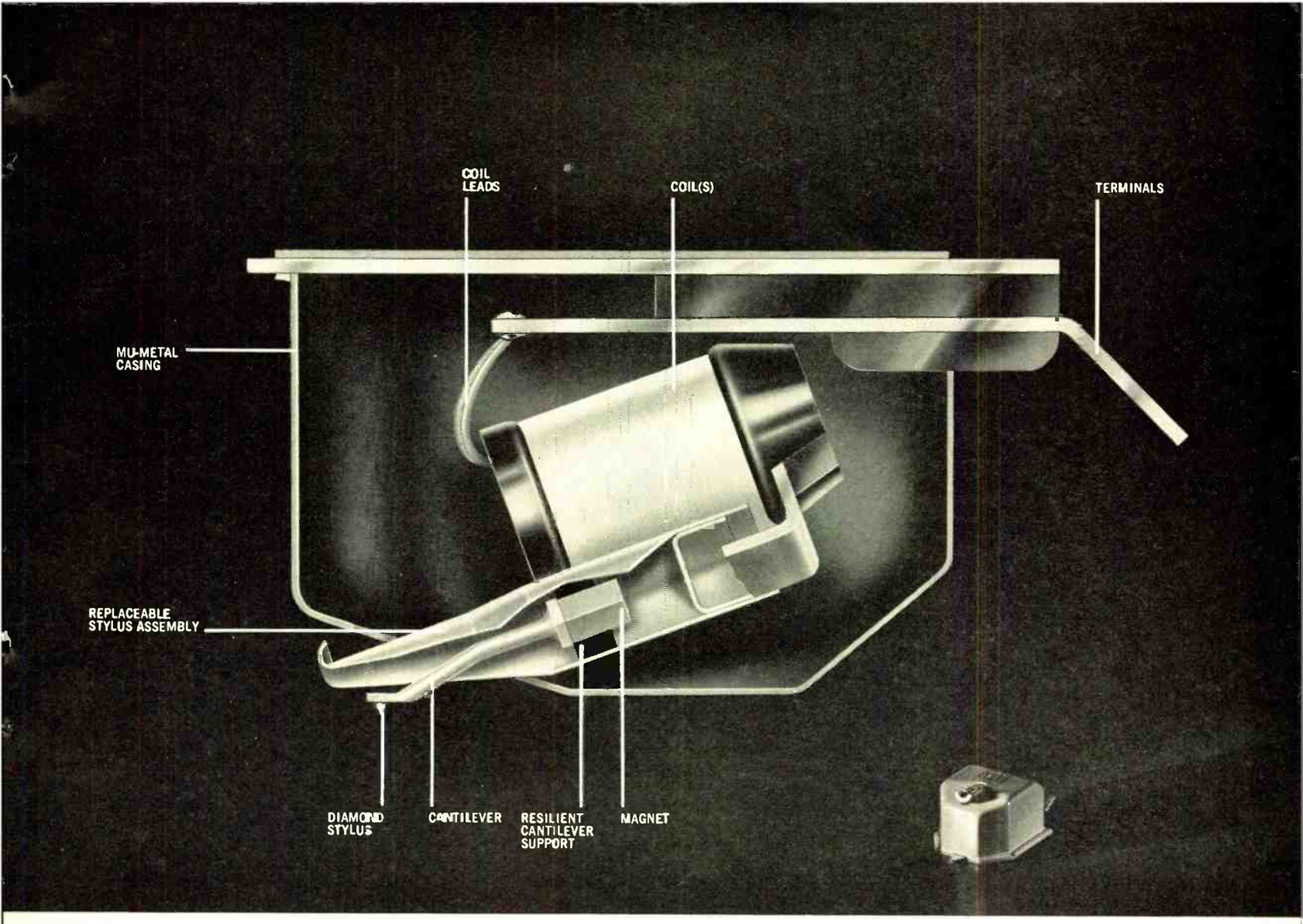
Signs of consolidation within the record industry continue to crop up. Bill Grauer Productions is now distributing the familiar red and yellow Montilla label that has long been familiar to record fans who know their way around in the Spanish repertory. Fernando J. Montilla was the first disc producer to apply truly hep American audio techniques to the recording of Spanish artists in their own country. His earliest discs in mono, pulsing with vibrant sound, certainly changed my mind about Spain as a source of recordings. Some years later, Montilla's first stereo records, issued when the disc industry was not entirely sure that it could pull off the stunt of two channels in a single groove, put him ahead of much of the competition. The range and clarity of the Montilla master tapes of that period were more than enough to give this label a distinct advantage when it began to release its first stereo discs. In this recent mono record, Montilla turns again to the leading tenor on its roster. Alfredo Kraus, Spain's best known recording star in the American market, is heard here in music taken from the sound track of the Spanish film "El Vagabundo y La Estrella." About one half of the record consists of light tunes from the pen of Ruiz de Luna. The rest of the material is a collection of popular operatic arias used in the film to showcase the Kraus voice. Perhaps the most novel touch to be found in the entire album is the spelling used for the name of the composer Franz Liszt. When first seen on the cover, the spelling of Liszt looks for all the world like a typical typo error. It's not till you encounter the same weird spelling on the record label that you begin to suspect that the Spanish really mean it when they put down the man's name as Franz Listz.

Earl Wrightson: Soldier of Fortune
Columbia CS 8625

The repertory for roustabouts gets a vigorous workout in this album by baritone Earl Wrightson. Just about every song recorded here is aimed at a male audience. If more record producers were to think along the lines of Columbia's Ernest Altschuler, the man responsible for production details in this album, record shops might have a larger percentage of male shoppers than they already have. Earl Wrightson has been proving himself one of the more versatile baritones on records these days. His extensive series of discs in which he costars with Lois Hunt have covered the major songs of Jerome Kern, Sigmund Romberg and Rudolph Friml. Wrightson's most recent album, "An Enchanted Evening on Broadway" (Columbia CS 8319) is one of the better collections of show tunes to come along in recent years. I would recommend it without reservation to anyone searching for clarity and relaxed authority in the interpretation of some of Broadway's leading songs. The items featured in this "Soldier of Fortune" album go back, for the most part, to an earlier day when songs of adventures were not afraid to wear their melody (and sentiment) on their sleeves. There are samples of old-fashioned operetta and film scores as well as excerpts from the musical comedies "Paint Your Wagon" and "Lady in the Dark." Norman Paris leads the orchestra in his own arrangements that are designed to mirror the restlessness of these Songs of the Open Road.

Larry Elgart: More Music in Motion
M-G-M SE 4080

Everything possible has been done in this recording to preserve the illusion of the seating arrangement the Larry Elgart band uses in its live appearances. Everything, that is, that could be managed while meeting the requirements of the modified "music in motion" being offered in the latest Elgart releases. The only change in the normal lineup of the band was the addition of a second guitar, harp and a little extra percussion. The side men sound comfortable and relaxed without the sound screens that once were so in vogue to keep sections of an orchestra apart for maximum stereo separation. The small amount of channel switching that takes place here is barely perceptible during the special arrangements created for this album by John Murtaugh, Lewis Gluckin and George Williams. Larry Elgart, an audiophile of long standing, has always been finicky about the sound of his records. Along with careful selection of mikes and painstaking followthrough in the entire recording process, Elgart takes advantage here of one of the simplest tricks to get clean sound on a stereo disc. He holds down the time of all selections so that they average only slightly more than two minutes in duration. If you take the trouble to add up the actual running time of the music on this record, you'll find that Side A totals fourteen minutes and Side B a mere twelve minutes. No wonder pop records of this timing offer realism you can't get on the average side of a classical stereo disc running 20 or 25 minutes. No amount of equalization in a pinched groove can give you the sweetly open sound MGM has provided in this release.



COMPLIANCE: can there be too much of a good thing?

Have you any idea of the quality you would hear from a record if the cartridge produced a perfect waveform of the sound groove? Yet, from all the talk you hear, you'd think *stylus compliance* were the only criterion of cartridge performance.

Admittedly, high compliance is essential if the stylus is to follow or 'track' the complex course of the record groove with reasonably low force. But, how high is high enough, and how much is too much?

While 'tracking', the stylus performs complex movements set up by the sound pattern pressed into the groove. But, the movement of the stylus doesn't produce the sound or the sound waveform. This is accomplished by the movement of the magnet which, as you can see from the cross-sectional view, is at the other end of the cantilever to which the stylus is affixed.

If magnet and stylus do not execute identical motion patterns, due to the slightest flexibility in the cantilever, an altered or distorted waveform will result. Quality and fidelity will suffer.

This problem becomes most acute with increased stylus compliance. For, in reaching for higher and still higher compliance, it becomes necessary to reduce the dynamic mass of all the moving components of the stylus assembly to the lowest possible magnitude.

The mass of the stylus itself is virtually fixed by the radius of the tip. Further reduction of the magnet mass is limited by minimum output requirements. But, the mass of the cantilever can be reduced by using less material. This, however, entails the risk of making it thinner, more flexible and more prone to bend during stylus excursions. This flexibility is often mistaken for compliance. It will, in fact, produce 'false' higher readings in compliance measurements.

As stylus compliance is increased, the tone arm also plays a more critical role. If arm friction is high with relation to the compliance of the stylus or—putting it another way—if stylus compliance is so high as to be greater than the arm's own compliance or responsiveness to the spiral action of the groove, the resultant 'drag' will prevent proper tracking. And if stylus force is increased to correct for this condition, the greater force is likely to compress or decenter the cantilever. In either case, distortion is inevitable.

The new Elac 322 is the culmination of an intense, year-long engineering program concerned primarily with improving cartridge performance. The ultimate objective was to achieve a cartridge without distortion, without crosstalk — a cartridge capable of reproducing a perfect waveform replica of the sound groove.

How close the Elac 322 has come to this ideal is evident from its performance. Specifications offer some clue. But, numbers can never convey the emotional experience in quality, the personal gratification that comes with hearing good music and good sound.

The new Elac 322 reproduces all frequencies from 20 to 20,000 cycles, ± 2 db, and with less than 2% intermodulation distortion. Interchannel separation measures better than 25 db at 1000 cycles, and over most of the spectrum. It measures 20 db at 10,000 cycles, and an incredible 12 db at 20,000.

The stylus has a compliance in the order of 14 x 10^{-6} cm/dyne. Recommended tracking force with most arms ranges from 1.5 to 3 grams. It will, however, track at 1 gram with some arms. A magnesium cantilever is used because of its lighter weight and greater rigidity than aluminum, the material most often used in stylus assemblies.

Price of the Elac 322 stereo cartridge with .52 mil diamond stylus is $49.50. Also available: Elac 222 compatable mono/stereo cartridge with .7 mil diamond stylus at $39.50. At your hi-fi dealer. For further details, write to:

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BIG GRAY BOX

There are tape recorders by the dozen available for the non-professional these days. Not many of them are both expensive and large—large enough to operate with 10½-inch reels. The consensus among the makers (and presumably the users too) is that the smaller a recorder is, consistent with quality, etcetc., the better it will sell. Note the phenomenal success awhile back of the Wollensack line, still available in several versions.

It was odd, then, that when I wrote up a monster-big home recorder, the Tapesonic, a huge, square, black box with no streamlining at all and no size constrictions, taking the big reels with room to spare, I was beseiged over many months with requests for more info. (The makers did not cooperate much; they never answered our readers' mail inquiries.) That big black box seemed to be the answer to many a home user's unpredictable dreams. Who's a-thunk it!

So now I've been trying another big one, a big gray box this time. It's a prettier package than the Tapesonic; this one if memory is right, is somewhat smaller—merely a large, fat suitcase. It has a handsome rough-gray finish, rounded sewn edgings and a modish handle. Without a doubt it is the heaviest single suitcase I ever hope to lift.

Enclosed is a striking big tape deck, brushed aluminum, with an astonishing number of black knobs on the front and rank after rank of gold-colored chassis in back. Preliminary close study reveals a bewildering wealth of stereo interconnections, inputs, outputs, alternative meter readings, built-in-echoes, dual-purpose pots, multiple feeds, etcetc., operating through twice three heads and two tracks—or four, if you prefer. All this and microswitch relays, photoelectric cells, miniature finger-tip control, three speeds, big reels, three motors, high- and low-impedence mike inputs (on mine, at least), and throughout an obviously solid, careful workmanship and quality reflected in the extremely fancy specs—and the fancy sound in the recording and playback.

The whole ensemble, in varying alternatives, goes under the name of the Crown 800 and costs plenty money. Though the line is distinctly intended for non-professional use, its price is quite professional. You'll want well over a thousand smackers to make it your own.

There is, indeed, a separate Crown line, the 800 BX line, which is a professional broadcast modification of the 800 series. The changes are relatively minor and the broadcast model costs a small percentage more. (Its electronics, for instance, are set for 0 db on Scotch 111 tape in reference to Ampex playback test tape, whereas the non-pro model is set down 2 db, for extra signal in half- and quarter-track configuration, and is referred to Scotch 120 tape.) It is thus clear that the Crown 800 line in its various options (and the somewhat simpler 700 series) is intended to adapt straight professional quality to non-professional uses. That is what you pay for.

Think Fast

What are the parameters, to use a familiar pro term, for a professional-grade recorder intended for non-pro use? There you have a prickly question.

The Tapesonic answer, large-size, was a remarkably low-priced machine providing basic high quality with a minimum of expensive frills and a maximum of space. No fancy relays, for instance, and a somewhat terrifying but very usable mechanical transport control system.

The Crown answer, involving a lot more cash, is a lot less simple. Here, you start with a professional-grade basic transport and electronics, ruggedly built and sporting ultra-high specs throughout, and you proceed to build on outward facilities, notably the controls and switching, to provide what the home user of advanced grade will presumably need according to his wildest dreams. The Crown has everything and more. (Almost, anyhow, though it lacks a few of *my* dream-desires, as we'll see.) It has so much that it threatens to get lost in its own labyrinths of ultra-flexibility. Phew! Like a plane cockpit, when you first look at it.

Want to play a recording and mix it with two other incoming signals, add bass and/or treble boost, throw in an echo effect and simultaneously re-record the whole thing back on the same tape? Can do. And you can read what's happening at all sorts of points via the two meters, if you can figure out the meter settings fast enough. Eight, all told.

This, it appears, is the only stereo machine in which the meter and sound switches are separately set up, each in several possible modes. And it's the only machine in which a bass and treble boost, a pair for each channel, can be thrown into the mixer in playback mode to doctor up any incoming signal and/or the played signal from one or both channels. (I think I have it right, anyhow.) Four little black knobs, plus two OUTPUT switches with Position A and Position B. In the record mode, they give the usual AB comparison, feeding out the input or the playback signal; but in the play-only mode Position A cuts in the bass-treble boosts, to taste, whereas Position B bypasses them—all this, if I get it right—into the mixer sections, for each channel independently, of course.

Then there are those meter settings. My old Ampex meter reads just input or output, according to signal connections, plus bias. The pair of Crown meters (somewhat smaller than pro standard but still big enough to read well) hitch up four ways, each. OUT shows signal at the cathode follower output or the lineout. Position A (again) here shows signal level being recorded. (I'm now quoting the instruction book.) Position B shows the playback signal level. BIAS shows the amount of bias current in the record head, indicated on the regular meter scale. (For Scotch 120, Crown says, set it at "100 per cent." Not a word about other tapes, but you are presumed able to experiment with them for proper output and bias.) OUT, A, B, BIAS says each meter switch, and the two are switchable to make 16 possible meter combinations. Note that you can read on either meter not only the direct playback from the tape but alternatively the final output, *after* any mixing and equalizing you have added. That is, if you can keep your head, and think fast.

Then there is the record lever. It has three positions, not a mere two: P, R, and E. P. is normal playback, or off. R, with a mechanical safety, is record. E is echo—it feeds part of the playback signal into the record channel. (You control the amount via the PLAYBACK volume control on the other side of the recorder and inevitably it is too much: the thing immediately overloads with a roar, until you get the playback control backed off.)

Transport? Three motors and dynamic braking, which works fine when the current is turned on. (Minus power, the reels are apt to unwind all over the floor.)

Effete Micro-clicks

The vital controls are all relay-actuated and give one a splendid sense of potency; these are the sort of pushbuttons that work with a micro-touch. The STOP bar, plus fast forward, run and fast rewind, are clumped close together under the thumb and three fingers of a casual right hand. No hefty pushes, no lunges, no clanks and bangs. Just a touch, and a set of effete micro-clicks, the ever-lovely microswitch sound. (Remote control operation is yours via a plug in the rear. I didn't try it.)

The heads are arranged inside a slot-type enclosure, with pressure pads mounted on an under-carriage affair that jumps upwards from below to hold the tape in place, via the usual solenoid action. There's a small toggle switch to the right, a mechanical "cue" arrangement, moving this same carriage up against the tape manually for audible search. Without it, the automatic elements won't let you hear a thing except in the play-record mode.

Somewhere inside the head-box is a relay that had me baffled until I found it in the instruction book. A photoelectric cell stops the machine whenever it doesn't find any oxide to look at. The book says you are supposed to scrape off oxide to make a transparent spot; I discovered the gadget much more simply. It thinks that white leader tape is transparent. When it sees leader tape it stops the machine—but your

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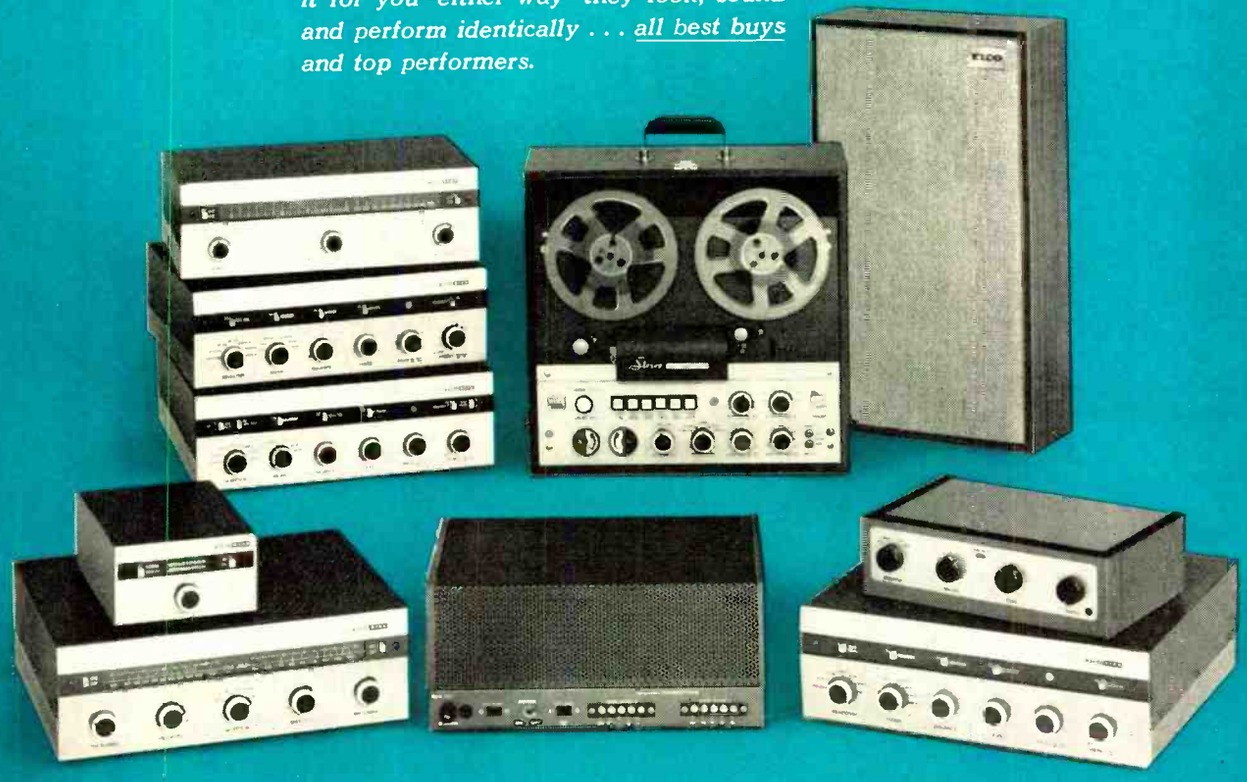

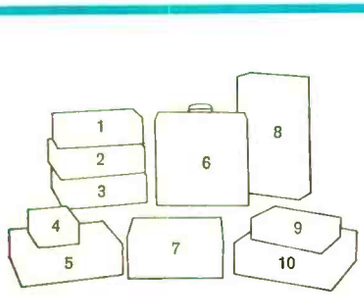

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fingertip controls will over-ride it, as I noted to my surprise. This machine has more tricks than a barrel of monkeys, as we used to say in the pre-tape days.

Pots? Arms? Plenty of the first and one of the second, its purpose and action somewhat erratic. On the front panels you'll find no less than six volume controls, all over the place, with ten different functions. Two level-sets in the rear add to the fun. All these affect volume—somewhere. Some are in parallel, so to speak, some in tandem. Each channel has four inputs, boiling down to two since the high-level always over-rides the low-level on the same input channel. I.e., on Channel A there's mike 1 and phono 1, a single combined input, and also mike 2 and phono 2, the same. On the front panel, a single pot controls either the mike or phono (low or high level). The two pots for mike 1 and phono 1 of each channel are to the left, the two for mike 2-phono 2 are on the right side, and next to them is the smaller playback volume control. A bit confusing? Well, that's what I'm talking about.

That arm, dangling springily on the right side of the head-box next to a fixed tape guide, had me stymied. No matter what I did with the tape, the arm wouldn't take up a proper stance as it should, to hold back and cushion the tape movement. Instead, it would bang up to the right, against its metal stop, or bang down the other way, or worst of all, it would oscillate violently back and forth, whanging the tape taut and loose. Once it broke the tape outright; often it came near to it, until finally in exasperation I pinned the thing down with some sticky paper sealing tape so it couldn't move at all. Then, at last, the tape moved quietly, though without the proper springiness in handling that ensures safety under emergencies.

Instructions

It seems I hadn't threaded the tape correctly. You see—and here's a key to much that is significant—I didn't then have the instruction book. Either it wasn't included or, more likely, I threw it out with the shipping-box innards. Anyhow, it couldn't be found, so I went to work to use the machine without it.

Now I have a very strong feeling that instruction books are vital and should be ultra-clear and *very* easily read, presenting all pertinent info in logical order of importance, in English, not Engineerish. But I have an even stronger feeling that any piece of good *home* equipment should be operable without an instruction booklet. Either the operation should be self-evident, to the man who is reasonably initiated, or it should be indicated somehow by the machine's own labels. Or failing this, at least the correct deduction should be possible after a bit of experiment. (Thus when Eico's tape deck showed, to my slight confusion, a pushbutton that said STOP and another which said OFF, it took me but a moment to figure that STOP was actually the *start* button too, turning power on as well as cancelling all motions.)

When I finally got the Crown instruction book, I discovered that the dangling arm must be threaded with a reverse S twist. Maybe I'm dumb, but I hadn't figured this at all for myself. So it seems to me that, the thing being less than self-evident, a means of indicating the tape threading could easily have been devised, *right on the machine itself*. Not pretty, but very useful. P.S. Crown says the arm can be by-passed for the slower speeds.

And so we come to an evaluation. I honestly do not think I need say ten words about Crown performance. It is clearly superb. The machine fairly reeks of careful workmanship and careful thought as well as high-quality material. A friend of mine has had a Crown for something like three or four years and has recorded miles and miles of top-quality tape. He seems as enthusiastic now as at the beginning and, more important, he has made no changes in his equipment that I know of. Good sign.

One might suggest, of course, that at its price the Crown had *better* work—and keep on working. Good point. Apparently, it does just that. I note in passing that a pertinent indicator of manufacturing care is the running-in of the main drive motor—*one hundred hours* before the machine leaves the factory. How many home recorders will run a hundred continuous hours at all, without burning up?

And so I move on, all in a spirit of constructive criticism, to elaborate a bit on what I have already ever so clearly implied—a certain cybernetic confusion that grows straight out of the Crown's fabulous operational flexibility. I'm not saying there it too much flexibility. I'm merely suggesting that it will take a good long while to learn to drive this machine with a sure touch and no errors. My head still swims every time I touch the fingertip controls to start a tape rolling; the dual-dual arrays of multiple-everything on the front panel begin to look like double images and, too often I frantically move my right thumb 1/32-inch on the little STOP bar, to bring the whole operation to a quick halt!

I'm not too sure that things could be much different. After all, you have to control the facilities you have, one way or another. (And the inside chassis configurations must somehow match up to the front-panel knobs.) I confine myself, then to a few suggestions for further study, blithely ignoring all inner problems of design and location. Crown can take care of *that*.

Position A?

1. Labels such as "Position A" are quite meaningless in themselves; a better abbreviation, or words, can be found, even if merely to recall what the instruction booklet explains in detail. Admittedly, Crown's ingenious multiple-use controls make this a tough proposition—still, there's room for betterment.

2. Somehow, I'd like to see the Crown controls, all twenty eight or so of them, more segregated as well as more explicitly marked on the panel.

It would be good if, somehow, the now almost standard division of functions into

(*Continued on page 52*)

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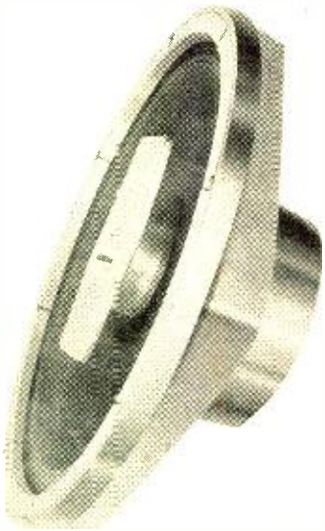

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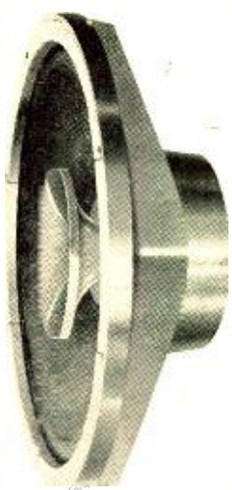
SPECIFICATIONS

Model No.	PAX-30L
Voice coil impedance	8 or 16 ohms
Resonant frequency	34—52 c.p.s.
Frequency response	43—20,000 c.p.s.
Power handling capacity	20 watts
Sensitivity	103 db/watt
Crossover frequency	3,000 c.p.s.
Flux density	Tweeter: 10,000 gauss Woofer: 9,500 gauss
Magnet weight	Tweeter: 1.2 oz. Woofer: 12.0 oz.



Model No.	PAX-30M
Voice coil impedance	8 or 16 ohms
Resonant frequency	34-52 c.p.s.
Frequency response	43-20,000 c.p.s.
Power handling capacity	20 watts
Sensitivity	103 db/watt
Crossover frequency	3,000 c.p.s.
Flux density	Tweeter: 9,000 gauss Woofer: 9,500 gauss
Magnet weight	Tweeter: 1.2 oz. Woofer: 12.0 oz.

Model No.	PIM-30L
Voice coil impedance	8 or 16 ohms
Resonant frequency	31-49 c.p.s.
Frequency response	43-20,000 c.p.s.
Power handling capacity	20 watts
Sensitivity	102 db/watt
Crossover frequency	3,000 c.p.s.
Flux density	9,500 gauss
Magnet weight	13.0 oz.

PIONEER

PIONEER ELECTRONIC CORPORATION

5 Otowacho 6-chome, Bunkyo-ku, Tokyo, Japan

Distributors: Canada · Importhouse of Canada, 2939 Eglinton Ave. E., Scarboro, Ont.
Singapore & Malaya · Hwee Seng & Co., 259 Beach Road, Singapore 7

EDITOR'S REVIEW

"PURPOSEFUL OBSOLESCENCE"

THERE IS A THEORY behind those words. More than a theory—a way of life.

As far as we are concerned, these words came to mind when we started to think about the difference between component high fidelity and what we generously call the "package" sets. At first we started to list distinct technical criteria. Good, this would soon separate the men from the boys. But it didn't, not completely. You see, we found ourselves comparing apples and oranges; the amplifier in a "package" is not really the same breed of animal as the component amplifier.

Perhaps it would be easier to state if we were to report an imaginary conversation between the "boss" package designer and the "powers-that-be."

Powers-that-be: Well, Boss, this year we need an entirely new line. First we'll need some sets in the $150 to $359 category.

Boss: Yes, P-T-B.

Powers-that-be: We'll need some new sales gimmicks so why don't you "do something" with transistors.

Boss: Yes, P-T-B.

Powers-that-be: Remember, this year the style is ancient pseudo Greek, so give us plenty of urns.

Boss: Yes, P-T-B.

Powers-that-be: Now remember, the profit picture wasn't rosy last year so we'll have to cut back some of our expenditures. How many engineers did you use last year?

Boss: Two on each project.

Powers-that-be: Cut back to 1½.

Boss: Yes, P-T-B.

Now, for contrast, we will report the imaginary conversation between the owner and chief engineer of a company which manufactures components.

C.E.: Well, Owner, do you think we can upgrade it ten watts more per channel? The magazine editors tell us that the fans want 60 watts per channel.

Owner: When I was at the show in Penciltucky everybody who came into the room was waiting for transistors.

C.E.: I'm not sure about transistors, besides they're very expensive.

Owner: It'll only cost the fan $50 more, he won't mind paying it when he hears the difference. Also we can save money by using plain brass knobs instead of those fancy ones, "he" would prefer it that way.

C.E.: All right, I'll stay late tonight and study it.

Owner: I'll stay with you.

Of course these imaginary conversations are obviously facetious, but they do point out the fundamental differences between components and "sets:" The set man is designing his equipment to fit a price slot and to conform to the style of the year; the component man is designing for performance.

But the style of the year changes, sometimes every year. That means that the "set" is going to be obsolete every time the style changes. The set designer knows that, so why design electronics that will last longer than the set? They don't. Instead they try to design every element of the package so that they will all become obsolete about the same time. Purposely.

There are some who say that designing the "death" of a product in is what makes the American wheels go 'round. They say that mass production depends upon it. Perhaps so.

The component people don't believe it, though, and we are glad that they don't.

(BAD) SOUND IN THE THEATRE

We have mentioned previously in these columns about the generally poor sound one experiences in the theatre. Frankly we were at a loss to understand why theatre people would permit their efforts to be masked by poor sound system design.

We believe we have unearthed part of the answer. It all hangs on a tale about a new sound system for a New York theatre. We became aware of this new installation some months ago, before it was installed. It took about a month to put the system in.

It was a tough job; the theatre is not ideally shaped for a reinforcement system. In any case, the job was done and it sounded fine, albeit not perfect. Next we heard that the system was being removed at the conclusion of a particular performance and was to be replaced for the opening of a new act within a days time. The firm to install the new system was one responsible for the sound of many Broadway shows.

We don't wish to prolong this story so we'll come to the point fast; the new system was horrible. In fact it was so horrible that it was ripped out after one night and the original system reinstalled.

Two salient points are outstanding in this story: Why in the world was the good system pulled out in the first place? Why did the new system fail so badly?

In answer to the first question we discovered that very few theatres have their own sound system so that a touring company normally takes its own system with it. This includes the famous, old-established theatres in New York. Thus, every time a new show starts a run at a theatre, a new sound system is installed. Here we have the reason for a perfectly good system being bypassed. Here we also have the basic reason that the replacement system sounded so bad: a system which is portable is most likely difficult to place in the best position to coordinate with the acoustics of the hall. Also it is very unlikely that a portable system would be the best choice for *any* hall.

What is really at fault here is the concept that a theatre should *not* have a permanent sound system, particularly designed for best matching of existing acoustics. What is needed is for the audience to complain about poor sound. Why pay to attend a show which can't be heard clearly, or the music is distorted?

AN INVITATION

During the forthcoming High Fidelity Show in Los Angeles (Ambassador Hotel, April 2–7) we will be on hand to answer questions, say hello, and talk about ideas for articles. Naturally we won't be in our booth all day long, but we will be there several times each day. We invite you to stop by and chat—we do enjoy talking to you.

We also received an invitation to attend the 1963 International Audio Festival and Fair in London. Thursday to Sunday, April 18 to 21 inclusive, if you can make it.

A actual size

This is the exclusive "floating stylus" in the Stereo Fluxvalve*, by Pickering. This stylus has so little mass it actually floats on water... so light it "floats" over the surface of your records at an amazingly low tracking force of 1 to 3 grams. At the merest suggestion of undue pressure on the arm or head, it retracts immediately into its Golden **SAFE V-GUARD®** soft plastic body. The Pickering "floating stylus" action protects your diamond and increases the life of your record while it plays.

Play it perfectly, play it safely with the Golden **SAFE V-GUARD** "floating stylus" by Pickering.

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NEW! Exclusive plug-in head assembly for automatic turntables Type A • Model AT6 Garrard—$52.50

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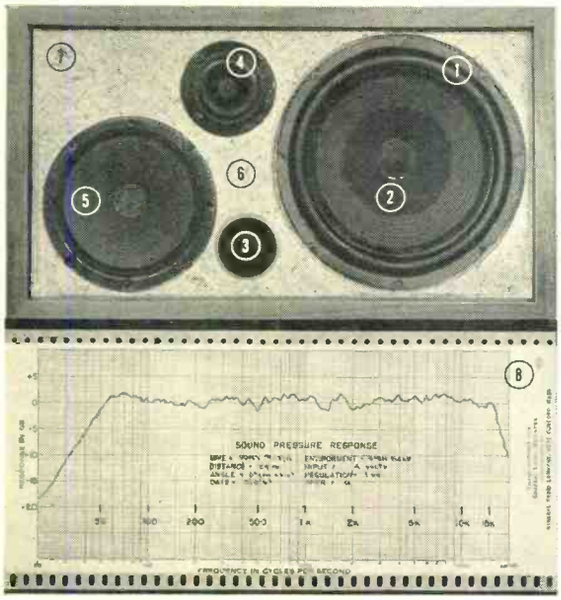
FOR THOSE WHO CAN HEAR THE DIFFERENCE

PICKERING & CO., INC., Plainview, N. Y.

*The hermetically sealed **STANTON** Stereo Fluxvalve is warranted for a lifetime and is covered under the following patents: U.S. Patent No. 2,917,590; Great Britain No. 783,372; Commonwealth of Canada No. 605,673; Japan No. 261,203; and other patents are pending throughout the world.

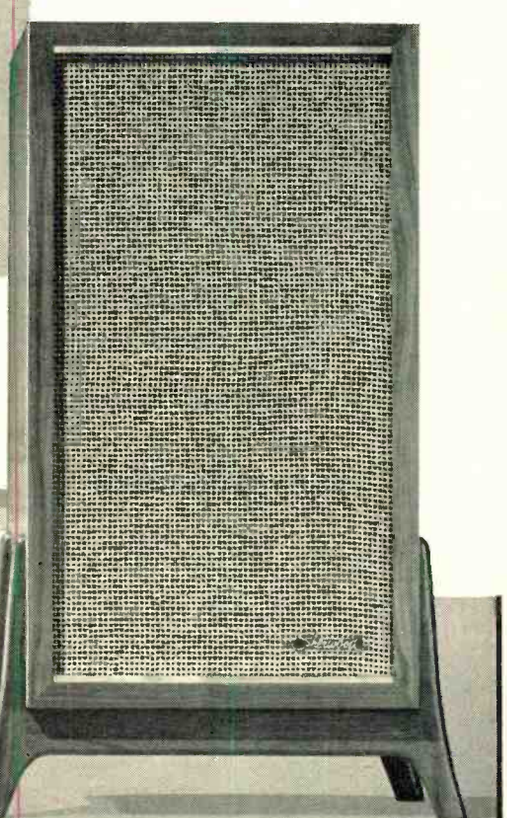


Sound pressure curve for Sherwood Ravinia Speaker Systems.

No other speaker system has more than 3 out of 8 quality features built into Sherwood speakers

1. **High compliance woofer** featuring single-roll suspension provides 21-cps free-air resonance for extended low-frequency response.
2. **Long-throw, 4-layer voice coil on woofer** boosts efficiency. One-inch linear cone motion minimizes distortion.
3. **Bass-port low-frequency reinforcement** increases power capability.
4. **Shallow-ring radiator tweeter** reproduces super-high frequencies with remarkable smoothness. Minimum annulus reflection and cavitation peaks.
5. **Midrange specially fabricated,** treated, and shaped to achieve smooth response throughout midrange frequencies.
6. **600-cps crossover network** is key to lack of "fuzziness" (low intermodulation distortion).
7. **One-inch resin-filled flakeboard baffle,** plus cross-bracing, provides rigid, non-resonant mounting for speakers.
8. **Individually tested speakers** are performance-matched. Response curves (see above) run on each system guarantee adherence to Sherwood's quality standards for use as stereo pairs.

READ WHAT THE EXPERTS SAY about Sherwood's Ravinia Speaker System. (the slightly larger version of the Berkshire). C. G. *McProud, Editor,* AUDIO, April, 1962—". . . solid, non-boomy bass, smooth midrange with good presence and clean highs." *Hirsch Houck Labs.,* ELECTRONICS WORLD, June, 1962—". . . response ± 5 db. from 27 cps to beyond 15,000 cps . . . sounds as good as it measures . . . unlike most, the woofer did not 'let go' or lose coupling to the room at any frequency down to 20 cps . . . high frequency sound almost indistinguishable from that of good electrostatic . . . good dispersion . . . no peaks." *Equipment Reviewers,* HIGH FIDELITY MAGAZINE, January, 1963—". . . the Ravinia confirmed its claim to response and then some. Bass was free of boom . . . midrange and highs were honest and clean . . . did not impart any particular coloration or tonal emphasis to any group of instruments or voice. Apparent sound source larger than cabinet size, yet system could be enjoyed fairly close up."



BERKSHIRE 3-WAY SPEAKER SYSTEM—**Response:** 53 cps to 17,500 cps ± 2½ db. **Power:** handles 50-watts program, 10-watts minimum drive. **Speakers:** 10-in., 8-in., and 3-in. **Cabinet:** Sides, top and bottom ¾-in. solid core walnut veneered plywood. All joints sealed against air pressure leakage. **Size:** 24 x 13 x 9½-in. deep. **Price:** $99.50, in genuine hand-rubbed walnut veneer. RAVINIA 3-WAY SPEAKER SYSTEM—Similar to Berkshire with following exceptions: **Response:** 48 cps to 17,500 cps ± 2½ db. **Power:** handles 60-watts program, 10-watts minimum drive. **Speakers:** 12-in., 8-in., and 3-in. **Cabinet:** Sides, top, and bottom, full 1-in. thick solid core walnut veneered plywood. **Size:** 26¼ x 15 x 13¼-in. deep. **Price:** $139.50, in genuine hand-rubbed walnut. OPTIONAL ACCESSORIES—Consolette legs (shown), $19.95. Pedestal bases, $9.95.

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Transistorized Audio Voltmeter

ALEX M. SCHOTZ*

This instrument for the construction-minded reader provides a high degree of accuracy and reliability. Using silicon transistors throughout, it frees the user from the limitations of a.c. power supply, and offers both flexibility and portability, in addition to saving considerable money.

Transistorized audio voltmeters have definite advantages over their vacuum-tube counterparts. The unit described here-in is a complete self-contained unit with its own power supply. This permits measurement of small a.c. voltages where these voltages are part of a high tension d.c. supply. Another advantage is that there is no capacitive coupling to the a.c. power line, which often produces erroneous readings when an instrument of this type is used in high-impedance circuits.

The specifications of the instrument described in this article compare with or surpass the standards of most good vacuum-type voltmeters. These specifications are shown in the box below.

Fig. 1. The completed a.c. voltmeter with ranges from 10 millivolts to 300 volts full scale—and fully transistorized.

Construction

In the construction of this instrument, the layout and dressing of the parts and leads are extremely important. In order to achieve any accuracy, the adjustments and calibration have to be made in the proper sequence.

The front panel layout is illustrated in *Fig.* 1. Proper location of the meter is essential since a large amount of space is not available. Most of the parts are mounted on a Vector board, as shown in *Fig.* 5, and the wiring of the Vector board is illustrated in *Fig.* 2. The resistors and capacitors on the rotary selector switch, *Fig.* 4, should be wired as a separate subassembly before being mounted in the case. The resistors and capacitors should all be dressed parallel to the back of the switch with the exception of the trimmer capacitor C_2. The section closest to the front of the case is wired to turn the instrument on and off and to provide for battery test.

The middle section of the rotary switch contains the resistors R_7, R_8, R_9, R_{10}, and R_{11}. Rear section parts are R_1, R_2, R_3, C_1, C_2, and C_3. Leads from the rotary selector switch to the Vector board and the input terminals are all made with 50-ohm co-axial cable. The outer braid is brought to the common return point on the selector switch which is a bare wire connected between the off terminals of the rear and middle sections.

The Vector board should be cut with a fine-tooth saw to the proper size and configuration, as in *Fig.* 2. After it is cut, the holes for the miniature controls, battery holder, and meter terminals should be drilled. The parts then can be mounted and terminals inserted. When wiring the board, the schematic, *Fig.* 6, should be followed carefully in conjunction with *Fig.* 2. The only parts mounted on the

* *Outboard Marine Research Center, Milwaukee, Wisconsin.*

Power Requirement:	1—8.1-volt mercury activator (In operation the meter consumes less than 4 ma.)
Transistor Complement:	1—2N1279 4 Ti495
Input Impedance:	In excess of 700k ohms measured at a frequency of 1000 cps
Voltage Ranges:	.01, .03, 0.1, 0.3, 1, 3, 10, 30, 100, 300 volts rms
Decibel Ranges:	The total range −52 to +52 db, each scale −12 to +2 db. There are ten ranges which are switch-selected from −40 to +50 db. Reference 0 db = 1 milliwatt into 600-ohm load, "dbm" designation.
Frequency Response:	1 db from 10 to 200 kc ± 2db from 200 kc to 1 mc. Down 3 db at 2 mc; will respond from 6 cps to beyond 3mc.
Amplifier Gain:	43 db with feedback through the meter; open loop over 62 db. This provides 19 lb of feedback through the meter.
Amplified Output:	0.8 volts rms with 10-mv input. Output impedance less than 500 ohms. Voltage at output terminals with full scale indicated on the meter will be in excess of 600 millivolts peak-to-peak.
Accuracy:	Within 4 per cent of full scale measured at 1000 cps full scale with 1 per cent resistors used in the voltage dividers. However, if accurate calibrating means are at hand and the voltage dividers' variations cancel each other, the accuracy of the instrument probably will be well within 3 per cent.

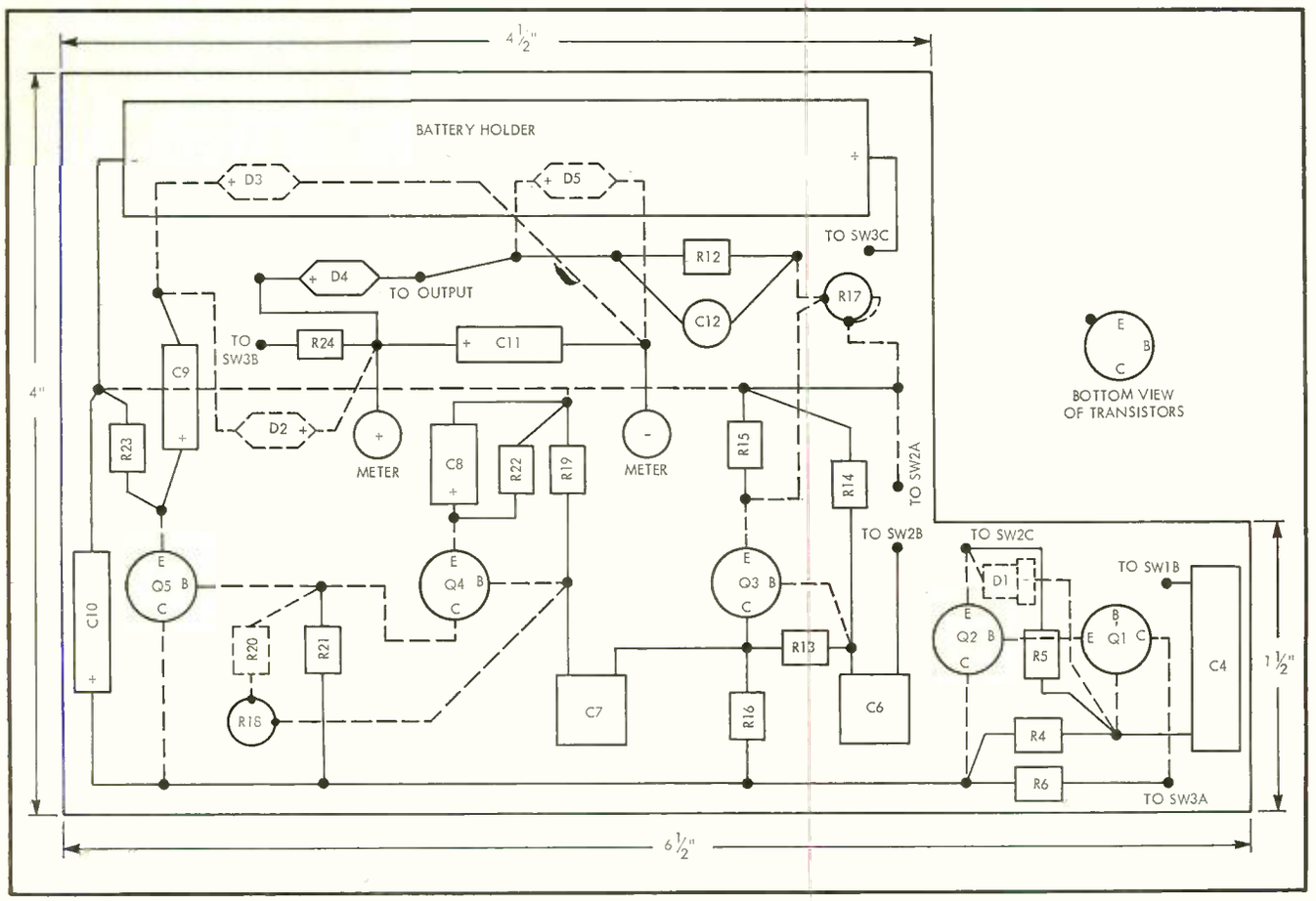

Fig. 2. Full-scale layout of parts on the Vector board. Components shown dotted are under the panel.

rear of the Vector board are Zener diode, D_1, germanium diodes D_3, D_4, and D_5, and the resistor R_{20}. Capacitor C_5 is connected between the common return point of the input terminal and the bottom right meter mounting bolt, looking from the rear of the case.

Figure 3 can be cut out and cemented on the meter dial face for indicating. *Figure* 7 can be employed similarly for the selector dial, input, and output markings by simply cementing in the proper position on the front panel.

Calibration

To set up and calibrate this instrument the following equipment is necessary:

(1) D.c. voltmeter, preferably with 0-to-10 or 0-to-15 volt scale

(2) Sine-wave audio generator

(3) A calibrated oscilloscope, or an accurate a.c. millivoltmeter.

When the instrument is completely assembled and wired, the back of the case is removed to permit making the adjustments from the rear.

With the instrument turned on, the 300-volt position, the positive probe of the d.c. voltmeter is placed on the emitter of Q_5 and the negative probe is connected to a common return point. R_{18} is then adjusted so that to obtain an indication of 4.0 volts on the d.c. meter (this is the power-supply center voltage). The next step is to apply a 10-millivolt rms sine wave at 1000 cps from an audio generator to the imput terminals. A calibrated scope or a.c. millivoltmeter can be used

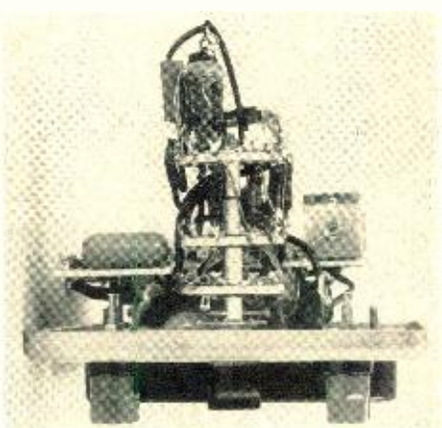

Fig. 4. Side view of the instrument to show the arrangement of parts on the selector switch.

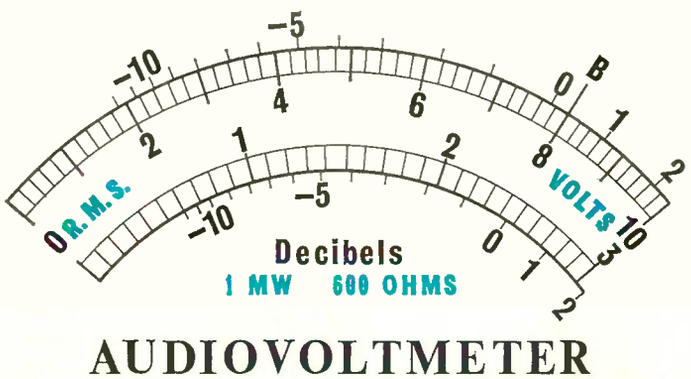

Fig. 3. Diagram of the meter scale. This scale may be cemented to the dial of the specified 200-μa meter.

to monitor the output of the generator. If a scope is used, the generator is adjusted so that .0283 volts peak-to-peak appear on the screen. This is equivalent to 10 millivolts rms. With this signal applied to the input, the selector dial is turned to the 10-millivolt position and then the feedback control R_{17} is adjusted so the meter pointer indicates full scale. Next, the selector dial is set to the 3-volt position, the frequency of the generator is adjusted to 100 kc, and the output of the generator set to 3.0 volts rms. If a scope is used as an indicator, the generator is set to indicate 8.5 volts peak-to-peak. Then trimmer capacitor C_2 is then

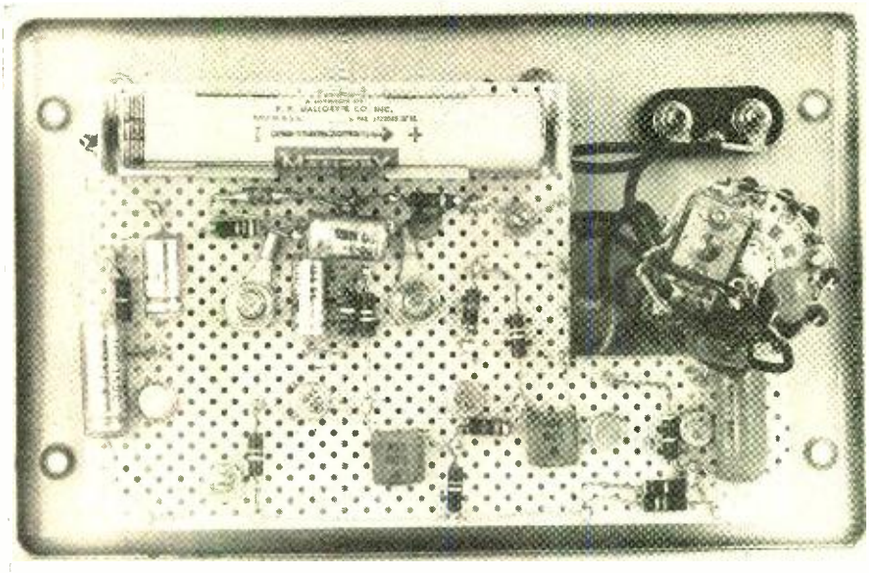

Fig. 5. Interior of the instrument showing the placement of parts on the Vector board.

adjusted so that the audio voltmeter indicates full scale. If the trimmer capacitor cannot bring the meter pointer to the right position, it may be necessary to pad capacitor C_3 with additional capacitance. The size of this capacitance has to be worked out by trying small additional amounts until the right amount is found which will permit adjustment of C_2. The audio voltmeter is now ready for use.

There are ten separate voltage ranges on this instrument, and the markings on the selector switch refer to full-scale voltage readings. When used to measure db, the meter is adjusted to obtain an indication, and this reading is either added to subtracted from the selector indication.

By feeding from the output terminals directly to the input of the scope this instrument can be used as a decade preamplifier for an oscilloscope. The output should be in excess of 0.6 volts peak-to-peak when the meter is at full scale.

Although the meter face is calibrated to read rms (Root Mean Square) volts, this only holds true with a pure sine wave. The meter actually responds to the average value of the input wave form. With any complex wave, special interpretation is necessary. There are articles and books providing this information, some of which are mentioned in the bibliography.

Circuit Description

Basically the circuit consists of a compound emitter-follower input feeding through a voltage-divider arrangement to two stages of voltage amplification in the common-emitter configuration. The output of the amplifying stage is direct-coupled to a common-collector (emitter-follower) stage which drives a modified bridge circuit for meter rectification. The return circuit of the bridge provides negative feedback to the first stage of voltage amplification.

A transistor is a current amplifying device and its input impedance is not like that of a vacuum tube, which can be almost infinite regardless of what configuration is employed. Common-collector configuration in a compound (Darlington or Super Alpha) circuit affords the

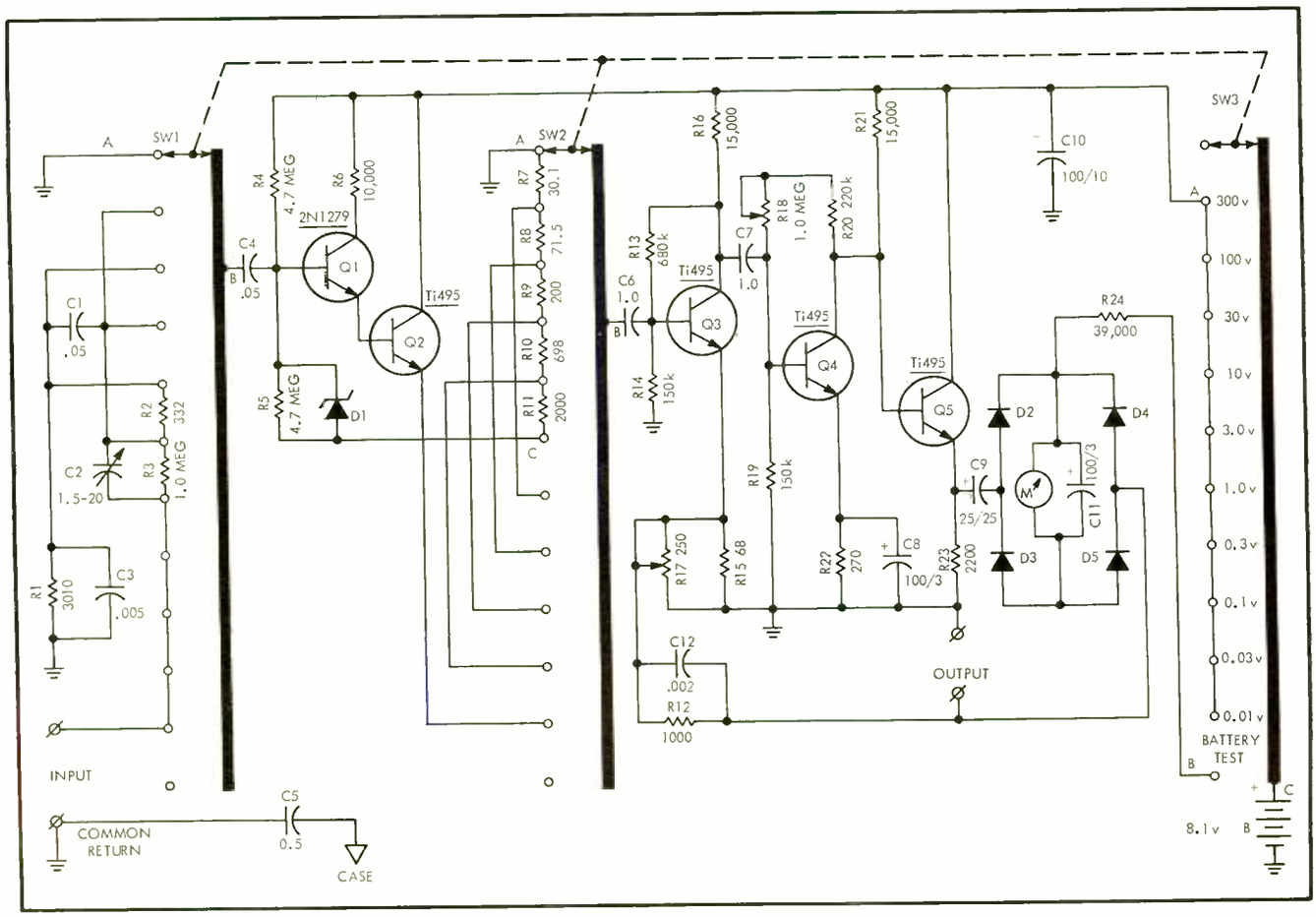

Fig. 6. Schematic of the transistorized a.c. voltmeter.

highest input impedance. However, the input transistor must have an extremely low I_{co} and, preferably, both transistors a high Beta. The input impedance of this arrangement is approximately the Beta of one transistor multiplied by the Beta of the second transistor times the emitter load, with this resistance calculated in parallel with the bias resistor. Also in the design of this instrument there are voltage-dividing resistors and capacitors (R_1, R_2, R_3, C_1, C_2, and C_3) in series with the input capacitor C_4, which is in parallel with the previously described impedance. As the input of this circuit is both resistive and capacitive, the effective input impedance will become lower at higher frequencies.

To protect the input transistors from damage due to the application of too great a voltage to the input terminals, a Zener diode limiter D_1 is included in the input circuit. This Zener diode is inactive and its internal resistance high until the voltage goes beyond its breakdown point.

Output of the emitter follower, Q_2, is part of the voltage dividing network, R_7, R_8, R_9, R_{10}, and R_{11}, which is coupled by capacitor C_6 to the first amplifying stage, Q_3. A 68-ohm resistor, shunted by a 250-ohm control wired as a rheostat, in series with the emitter of Q_3 has a two-fold purpose: it provides degenerative feedback for the first amplifying transistor Q_3, and it is the return path for the inverse feedback loop from the meter rectification circuit. By adjusting this control, the over-all gain of the amplifier can be fixed. As a result of this method of feedback, great stability is achieved and the sensitivity is practically independent of frequency over a much larger range than would otherwise be the case.

The output of the first amplifying stage is coupled through capacitor C_7 to another stage of amplification, Q_4 where the a.c. signal is further amplified and direct-coupled to the output stage, Q_5, which is an emitter follower. The output stage drives the meter rectification circuit. Bias control R_{18} is adjusted so that center supply voltage appears across the emitter resistor R_{23} of Q_5. This allows maximum voltage swing across the output before clipping. The meter rectification circuit consists of a full-wave diode bridge with a large capacitance in parallel with the meter for electrical damping of the meter movement. The rotary selector switch is arranged so that as it is rotated clockwise from the OFF position the highest voltage range is selected first, and when continuing in this direction the sensitivity is increased.

The condition of the battery is indicated on the meter face when the selector switch is turned counterclockwise from the OFF position. If it is above the "B", it is satisfactory; if it is below the "B", the battery should be replaced.

Accuracy of this instrument is governed by: (1) the meter movement; (2) the precision resistors used in the voltage dividers; and (3) the accuracy of calibration. Meter movement accuracy is ±2 per cent of full scale. Therefore whenever possible it is better to use the upper two-thirds of the meter scale—a practice which applies to any meter observation.

There are only a few commercial models of transistorized a.f. voltmeters on the market, and these range in price upward from about $165.00. The considerable saving resulting from the construction of this unit is typical of the cost difference between factory-built instruments and these constructed by the user. In the absence of an audio generator, the basic voltage calibration can be made from the 117-volt a.c. power line, using the 300-volt step and adjusting R_{17} to obtain the 117-volt indication on the meter. While this is not extremely accurate, it would at least provide a starting point. At worst, it is not likely to be more than 5 per cent off. This method would not provide compensation for frequency, of course, since the setting was made on the basis of 60 cps. However, for making comparative measurements—which are after all the most important—this method of calibration should suffice. Æ

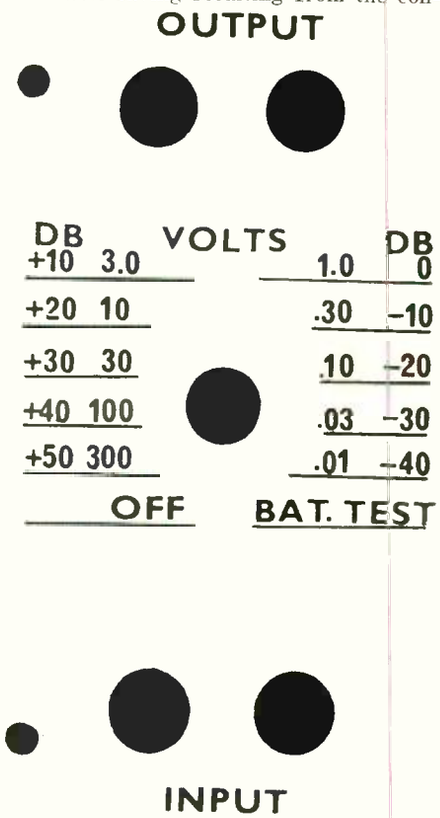

Fig. 7. Panel designation for the cabinet, also suitable for cementing to the front panel.

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"Handbook of Electronic Measurements," Volume 1. New York: Polytechnic Press of the Polytechnic Institute of Brooklyn, second printing, 1958.

PARTS LIST

R_1	3010 ohms, IRC DCC resistor, ½ watt
R_2	332 ohms, IRC DCC resistor, ½ watt
R_3	1.0 meg, IRC DCC resistor, ½ watt
R_4, R_5	4.7 meg, ½ watt
R_6	10,000 ohms, ½ watt
R_7	30.1 ohms, IRC DCC resistor, ½ watt
R_8	71.5 ohms, IRC DCC resistor, ½ watt
R_9	200 ohms, IRC DCC resistor, ½ watt
R_{10}	698 ohms, IRC DCC resistor, ½ watt
R_{11}	2000 ohms, IRC DCC resistor, ½ watt
R_{12}	1000 ohms, ½ watt
R_{13}	680 k ohms, ½ watt
R_{14}, R_{19}	150 k ohms, ½ watt
R_{15}	68 ohms, ½ watt
R_{16}, R_{21}	15,000 ohms, ½ watt
R_{17}	250 ohms, Centralab TMXO (500 ohms)
R_{18}	1.0 meg, Centralab TMXO
R_{20}	220 k ohms, ½ watt
R_{22}	270 ohms, ½ watt
R_{23}	2200 ohms, ½ watt
R_{24}	39,000 ohms, ½ watt
C_1, C_4	.05 µf, 600 volts, Sprague "Orange Drop"
C_2	1.5–20 pf, miniature trimmer
C_3	.005 µf, 600 volts, Sprague "Orange Drop"
C_5	0.5 µf, 200 volts, Sprague "Orange Drop"
C_6, C_7	1 µf, 25 volts, Sprague 5C13 Ceramic
C_8, C_{11}	100 µf, 3 volts, subminiature electrolytic, Sprague TE10-59.5
C_9	25 µf, 25 volts, subminiature electrolytic, Sprague TE1207
C_{10}	100 µf, 10 volts, subminiature electrolytic, Sprague TE11-19.3
C_{12}	.002 µf, 1000 volts, ceramic, Centralab 202
D_1	1N1512, 10-volt Zener diode, ¾ watt, Int'l. Rect.
D_2, D_3, D_4, D_5	1N56A, high-conductance diode
Q_1	2N1279, Texas Instrument transistor
Q_2, Q_3, Q_4, Q_5	Ti495, Texas Instrument transistors
Sw	3-pole, 12-pos rotary; Centralab 2008
M	200-ua, 4½" rect. meter, Simpson
	Keystone Battery Holder
	Bud utility cabinet, CU585
	Vector 32AA18 prepunched terminal board
	100 Vector T28 push-in terminals
	3 ft. 50-ohm RG58A/U coaxial cable, Belden 8529
	11/16" knob, Harry Davies 1400
	2 sets G-C Electrocraft binding posts, 33–292
	Mallory 8.1-volt mercury battery, TR136R

(The complete kit of parts, except battery, is available from Allied Electronics, 100 N. Western Ave., Chicago 80, Ill., at $71.95, under the catalog number 39A792. When purchased separately, the parts will total $74.67 plus battery, which is an additional $2.18, for an overall total of $76.85.)

A Wall-Projection Color Organ

MORRIS DOLLENS*

Concluding the construction details of a musico-optical instrument designed to entertain the eyes while the ears are being entertained

Part Two of Two Parts

The two-lamp boxes used under the panels are mounted with brackets made from light aluminum stock, screwed to the boxes, and held to the panels by thumb nuts to facilitate easy removal for lamp replacement (*Fig.* 10).

The four boxes were fashioned by hand, on a weekend when the stores were closed, but the size and construction match a commercial box, $2\frac{1}{8} \times 3\frac{1}{4} \times 1\frac{5}{8}$ in., (*Fig.* 11 and 12). Two sockets are mounted under the $\frac{3}{4}$-in. diameter holes, spaced out with nuts to allow air to enter; the ears of the socket flanges (which are slightly convex) are flattened in a vise to fit flatter over the screws. Check each socket with a lamp to be sure the lamp will go in; otherwise the socket must be mounted slightly farther out from the box wall with additional nuts. The fiber inserts should be fastened in place with size 3 or 4 screws or they will eventually loosen with the heat.

Four $\frac{1}{4}$-in. holes may be drilled at the two back corners of the box cover, with small shields (to prevent light leakage) covering the holes in a direct line with the filaments. A simple L-shaped shield in the center of the cover divides the box into two compartments so that the light from one does not mix with that of the other. Two $1\frac{1}{8}$-in. diameter holes, which could be square as well, on the front of the box, allow the light to emerge, and two strips of metal above and below the pair of holes allow small sheets of colored gelatine to be clamped in place over the holes.

* *4372 Coolidge Ave., Los Angeles 66, Calif.*

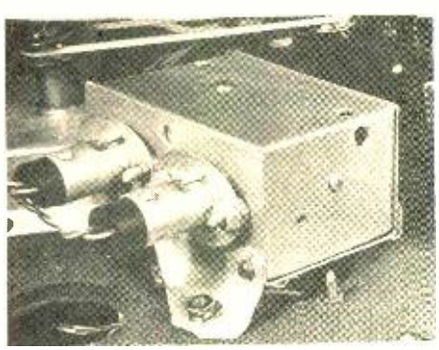


Fig. 10. The dual-lamp boxes beneath the panels are mounted with thumb nuts through small angle-brackets for quick replacement without tools.

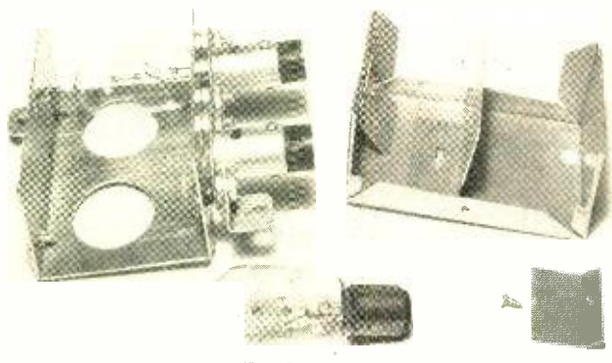


Fig. 11. The disassembled view of one of the dual-lamp housings shows the method of mounting the sockets, ventilator shields, and lamp-separator mask.

The transparent color-lens wheels can be made of plywood or Masonite (*Fig.* 13), or metal; rippled or lens-like glass, obtained at a large glass supply house and referred to as cross-reeded glass with $\frac{1}{2}$-in. squares, or rippled glass taken from odd glassware found in variety stores, is mounted in holes in the wheels, which are mounted on clock motors or pulleys driven by belts. After a struggle to cut this bumpy glass to fit pre-cut holes in the Masonite discs with little success of a fair fit, the obvious solution appeared to be to cut the glass first, outline the shapes on the Masonite, and then cut the holes to fit with a coping saw after drilling a $\frac{1}{4}$-in. starting hole for the blade. If the Masonite tends to break or split with the strain, clamp the material with the edge being sawed just above the jaws of a vise to support it while sawing, turning and re-clamping with each new cut. Metallic cement was used to secure the glass in the holes; household cement should work as well.

Using pieces of 1/16-in. aluminum for frames, 2×4-in. sections of the cross-reeded lens-glass have been mounted about 2-in. above the discs (*Fig.* 14), projecting part of the disc-pattern in modified shapes, and reversing the apparent direction of this part of the pattern, increasing the variety of motions in the images. These are optional, but worth experimenting with.

Six rotating reflectors are used in addition to the six rippled-glass wheels. The cylindrical lamp housings are mounted above these reflectors on metal arms attached to long brackets. Check to see if the cover of the cabinet will close over the taller of the brackets. Bits of cut mirrors have been glued to the center of some of the reflectors to add variety to the patterns.

Large plano-convex lenses are mounted on brackets, telescoping and slotted to adjust focus, over three of the wrinkled reflectors, projecting brighter spots of the colored lights to the upper portion of the screen where the reflectors alone will not adequately reach. About $2\frac{1}{4}$ to $3\frac{1}{2}$-in. in diameter, with focal lengths of about 3 to 7-in. the lenses are attached

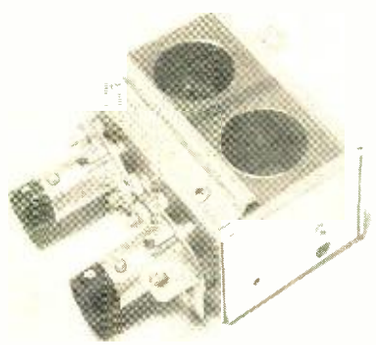


Fig. 12. The assembled dual-lamp housing shows the small mounting brackets, and the metal clamping strips to hold gelatine or glass sheets.

Fig. 13. One of the glass discs is shown in its Masonite frame, mounted on a ball-bearing pulley.

to light frames, by small ears of metal; the frames are made from the metal of old 16-in. aluminum transcription discs, but other metal would serve.

Another possibility is to use a number of smaller lenses of the same focal length mounted close together in a small masonite panel in place of the single lens, which would project a multiple image of the rippled reflector. Some adjustment is necessary to position the lenses properly.

A number of terminal strips (*Fig.* 15) greatly simplify the wiring of the three color-wheel panels. An octal plug from the thyratron amplifier feeds a strip with 8 terminals used to distribute the line voltage to the motors (with a slide switch to shut them off while adjusting or photographing) and to the strips which further distribute the music signals to the various lamps in their housings. An eight-foot home-assembled cable of 12 wires goes out to the manual remote control box (*Fig.* 16), consisting of three rotary 2-pole 4-position nonshorting selector switches used to vary the pairs of lamps in use in each channel, giving four different combinations with one lamp of each color at right and at left on at all times (*Fig.* 17). In use, each switch is rotated while the music is soft in that particular channel, which prevents sudden shifts in the bright patterns and also helps to subdue surges of current which shorten the life of the lamps. A clock-motor could rotate the switches automatically, but could not select the darker times to change, which would leave something to be desired in the way of esthetics.

Burnout of some of the lamps (with 150 volts applied) was noticed during the manual switching, caused in part by a rotary switch that occasionally allowed two lamps to parallel in series with one lamp which received a disproportionate percentage of the available voltage. Another reason seems to be that there is a momentary surge of voltage if the lamps are switched during the loudest part of the music, so that it is best to select the quieter parts of a particular channel to change the selector switch manually. Reducing the applied voltage to 120 volts, through dropping resistors, seems to have solved the problem of burnouts; none has occurred since.

Since the full voltage of the combined plate windings appears across some pairs of the wires in the cable, care must be used to select insulation which will stand the full potential. No trouble has been encountered using standard 500-volt hookup wire; cuts and nicks in the insulation should be avoided, and an outer layer of plastic tape would help to prevent this.

The switchbox is bent of soft aluminum. One point which was not noticed in the portable unit, but became apparent after working with the unit, was the need to get back farther from the screen when adjusting the brightness and timing-decay switches; an improvement in ease of operation would result if most or all of the controls were remotely controlled a few feet from the screen, and this idea should be strongly considered, if a large area is lighted. Shielded cables can be used for the high-impedance audio lines, with the slight high-frequency losses above 4000 cps ignored, for they contribute little to the visual effect. Possibly the easiest method of remote controlling might be just to

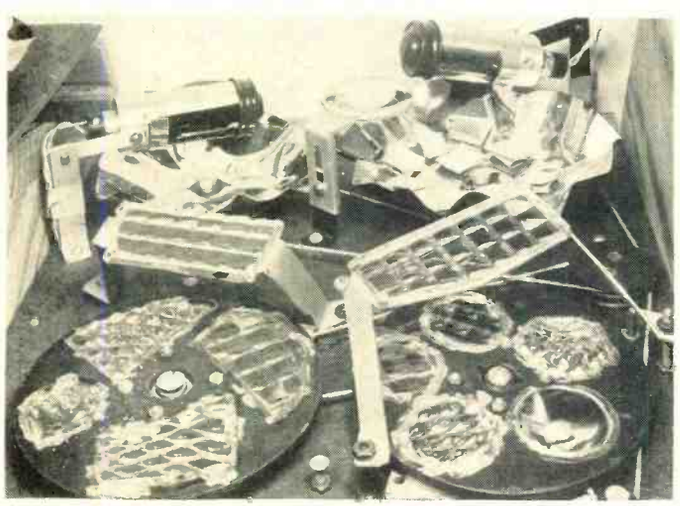


Fig. 14. The mounted cross-reeded glass plates and adjustable-mount plano-convex lens are shown in place on one panel; the latter can be focused with the slotted groove.

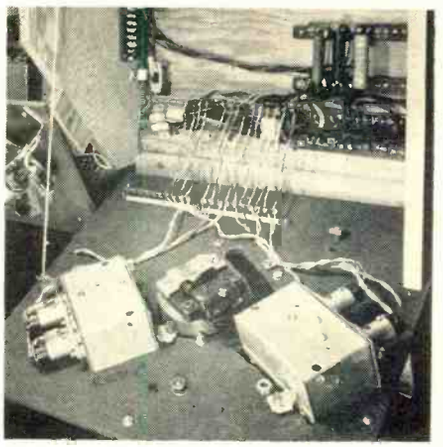


Fig. 15. A number of terminal strips are used to distribute the voltages, simplifying the wiring. The 1-rpm clock motor is on the left, and the series dropping resistors for the lamps are at the upper and lower right.

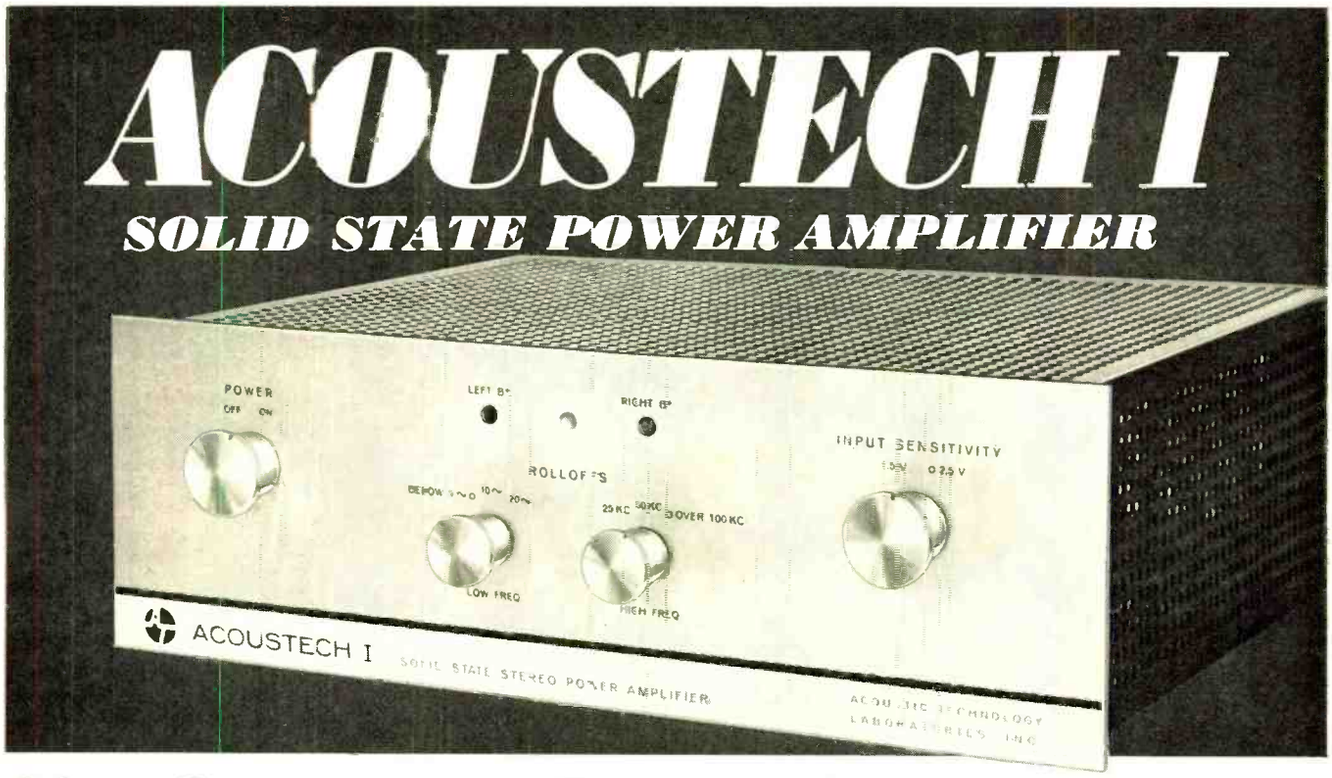
situate the whole amplifier remotely, with possibly the one or more TV transformers located in the projector cabinet to avoid moving around the heavy weight.

Color-Wheel Drives

An old midget fan motor, equivalent to a two-pole phono motor, and a surplus 800:1 gear reduction box, form the basic drive for one side of the unit (*Fig.* 18), although the difficulty of exactly reproducing the unit shown depends upon the experimenter's access to the gear box. Many odd gadgets are on the surplus market, but differing widely in various localities, so exact directions to build this type of unit cannot be given. Sometimes it might seem easier to supply the 24 volts d.c. required to power some of the geared reduction motors available from military surplus than to add gearboxes to existing motors. In the unit shown, the gearbox shaft is attached to a double pulley, which in turn operates four other ball-bearing pulleys attached to the color wheels. The ball-bearing pulleys make the mounting very easy, as a ¼-in. machine screw is inserted in the hole, and bolted directly (with a spacer-washer between if desired) to the ¼-in. Masonite panel, avoiding any necessity of setting up a shaft or bearing. Two lens-discs are run off one of the drive pulleys, at a slightly slower speed than the drives, for the disc pulleys are about one-and-a-half times the diameter of the driver pulleys, and the speed here is about 4 rpm. The two reflector discs are run off another of the drive pulleys, but using ball-bearing pulleys nearer 3½-in. in diameter, resulting in about a three times reduction in speed over the 1¼-in. drivers. Rather than using rubber bands as belts (which tend to jiggle and jerk at very slow speeds, although they seem to work well at higher speeds such as between the motor and gearbox), heavy twine or dial

ACOUSTECH I

SOLID STATE POWER AMPLIFIER



"...better than the best..."

states renowned audio expert Julian D. Hirsch* in February, 1963 Hi-Fi/Stereo Review.
Read these excerpts from his report on the Acoustech I solid state stereo power amplifier...

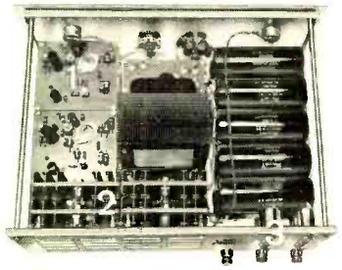
"... the listening quality ... had all the effortless, unstrained character of the finest and most powerful vacuum tube amplifiers, plus that undefinable 'transistor sound'... a dry, tightly controlled, and highly transparent quality ... the Acoustech I is easily the equal of any vacuum tube amplifier I have ever heard, and in my opinion a shade *better than the best* ..."

"... the finest square wave response I have ever observed ... absolutely no ringing or overshoot ... 30,000 cps square waves looked better than those I have seen from many fine amplifiers at 10,000 cps."

"The performance specifications ... are impressive ... because of unusually rigorous (and realistic) standards employed ... I am happy to say that the Acoustech I met or exceeded all its specifications for which I was able to test [advertised specifications: 40 watts per channel rms, 8-16 ohms, 20-20,000 cps, less than 0.95% harmonic and IM distortion with both channels operating simultaneously]. Its power output at most frequencies (with 8 ohm loads) was far in excess of rated values, measuring nearly 70 watts per channel at middle frequencies, and better than 60 watts per channel between 50 and 20,000 cps at 1 percent distortion ... distortion at levels of 10 watts or less was about 0.2 percent."

"... in its design and construction ... resembles industrial or military equipment [see figure at right] ... its circuits are assembled on glass epoxy boards [1] ... each output stage uses four silicon power transistors which are mounted on large finned heat sinks [2]. A quick acting fuse [3] protects each output stage from damage caused by overdriving or accidental shorting of the output terminals."

"The unit sells for $395 ... For those who can afford it, however, I think it is worth every cent of its cost."



*Julian D. Hirsch, co-director of world famous Hirsch-Houck Laboratories, has long been recognized as one of the most reliable and discriminating experts in the field of audio testing. He was formerly associated with the highly respected Audio League, a testing organization known for its early recognition of significant new breakthroughs such as accustic suspension loudspeaker systems.

IMPORTANT OFFER Fill out this coupon to receive (1) complete reprint of Julian Hirsch review; (2) reprint of descriptive article on Acoustech I published in January, 1963 Audio; (3) Full technical specifications on both the Acoustech I and II solid state stereo decade control center; (4) Acoustech's new booklet "Why Solid State Amplifiers Can Sound Better"; and (5) a list of dealers from whom a demonstration can be heard.

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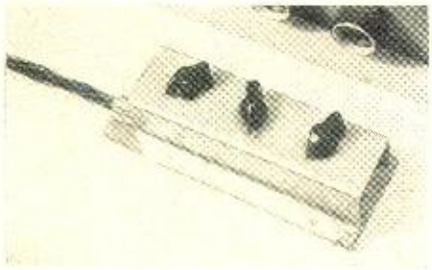

Fig. 16. The remote switchbox to select various combinations of lamps is shown in front of the amplifier panel.

cord is used, and the slack is taken up by a tension roller on an arm, spring loaded to produce the necessary friction.

If the organ is closer than 18-in. to the screen, it may be necessary to tilt up the lower reflectors by about 15-deg., and the belts may slip off the drive rollers unless small guide rollers on brackets are installed.

Another method of running the discs is by friction drive, similar to many phono turntables (*Fig.* 19). A somewhat larger clock-type motor was available at 1 rpm, and on this was mounted a wooden disc turned on the lathe to fit snugly inside a flat vacuum cleaner belt about 2¾-in. in diameter; contact cement was used to fasten the belt on, and abrasive paper gave "tooth" to the rubber face. A setscrew can be put in the wood at an angle, or for more positive drive, another of the halves from an insulated coupling can be attached. The four driven wheels are turned of wood on the lathe, but were first jig-sawed on a pivoting bolt into almost perfect circles, and at the slow speed operating here, merely sanding would probably be sufficient. Well-centered can lids of approximately the right size might serve, if there is no means of making the discs.

The two right discs are mounted solidly to the panel, and are driven by rubber friction idler assemblies taken from old phono turntable drives; but to reverse the direction of the two left discs, thus varying the directions of motions in the various discs, they are driven directly from the rubber-covered motor disc. To achieve constant pressure and good contact even though the discs may not be accurately centered, the two left discs are mounted on pivoting arms, in a manner similar to the tensioning arms in the other belt-driven panel (*Fig.* 20). An aluminum strip about $\frac{1}{8} \times \frac{3}{4} \times 4$-in. long was used for each although iron or brass would be satisfactory. A 3/16 or ¼-in. hole at one end of each acts as a pivoting bearing, and with the very tiny rotation involved, a machine screw without a straight shank was used, the threaded section not seeming to produce any amount of wear over a period of time. A tensioning spring is installed in another small hole near the swinging end of the arm, and is stretched out to a screw-post at an appropriate position so as to bring pressure between the rotating disc and the motor-drive disc.

The center panel is driven from another clock motor, a ⅕-rpm unit, which necessitated speeding up the reflectors about four times with gears, and causing much trouble with the resultant strain upon the small shaft in the clock motor, as the gear repeatedly slipped until a new, larger shaft was turned on the lathe, and larger bearings installed—an emergency operation over a weekend, not advised for those without full shop equipment. A simpler solution is to procure a 1-to-5-rpm motor and slow it down with pulleys.

The pulleys used on the center panel work with a string belt in the manner similar to the first panel described, with a small pulley on an idler arm to take up the slack. The large central glass disc is a surplus lens for an X2A NAN Beacon, 5¼-in. in diameter, while the smaller one is a piece of the lens-like rippled glass, mounted in a masking disc of Masonite; both discs are fastened with contact cement to thick Masonite washers and to the 1¼-in. diameter ball-bearing pulleys mounted on the panel. If the string belt tends to slip on the pulleys, try rubbing it with rosin, or a dial cord preparation, or else cover the bottom of the pulley groove with masking tape.

Three 7½-watt lamps are mounted in small light-shield boxes, made of tin-can stock, close beneath the discs and positioned so that the images seem to move in different directions—right, left, and up for the red, green, and blue. Since only one lamp is used in each circuit, a 3000-ohm 10-watt wire-wound resistor is inserted in series with each lamp. The lamps are of course optional; they are wired to work constantly during the music cycle, and are not switched about, producing sharp linear patterns in the lower center of the wall screen.

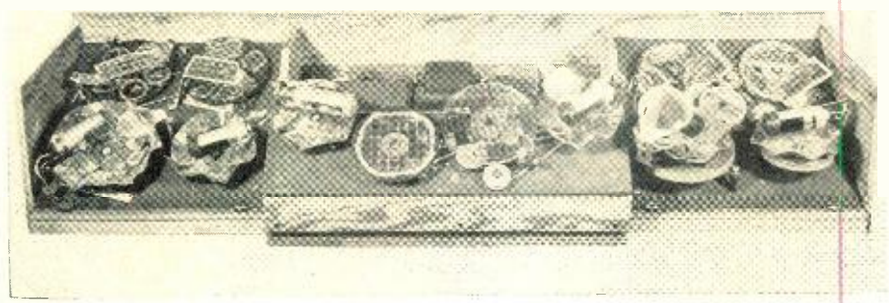

Fig. 17. A back view shows the general layout of reflectors.

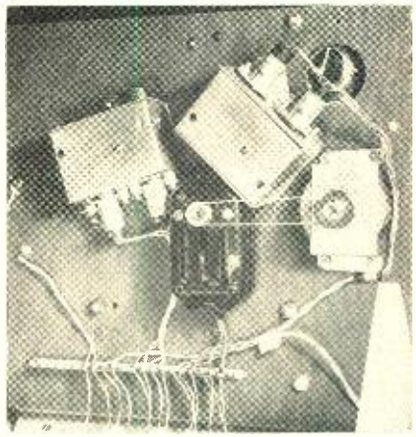

Fig. 18. A back view of the gear-box-driven side shows the small induction motor used; a rubber-band belt connects the pulleys. Terminal strips connected with flexible wires allow the panel to be hinged.

Another variation of driving the color wheels is possible by combining parts of two old phono motor assemblies, using a gear-driven 78-rpm motor shaft, turned or ground down to about 3/16-in. diameter, operating through an idler wheel and contacting a 9 or 10-in. rim-driven turntable. The combination runs at about 2½-rpm. By using one large reflector disc mounted on the turntable, but spaced out with long bolts and spacer tubes to prevent interference with the friction drive if this is mounted outside the turntable, the drive becomes quite simple, although it is likely that on the small screen it would seem to rotate about the center. By using the central 9-in. section to mount reflectors with their lamps mounted in front, and cutting holes in the outer edge of a 16-in. diameter disc to contain the rippled glass pieces, with their lamps mounted underneath the mounting panel, more variety is possible. By using an additional small piece of the rippled lens-glass to project the images of the disc glasses, the apparent direction of the projected images of the outer row of lamps will be reversed, creating more variety of directions.

Since there is only one speed for everything, the only way to vary the combinations of the patterns here is to have more lamps, preferably the 7½-watt variety, on switches so that their relative positions may be changed occasionally. Of course, this method of drive could be used in combination with the others in a larger installation, possibly behind a large translucent screen. If no geared turntable motor is available, a 78- or 33-rpm rim-drive turntable

(*Continued on page 64*)

AR-3 PLAYBACK:

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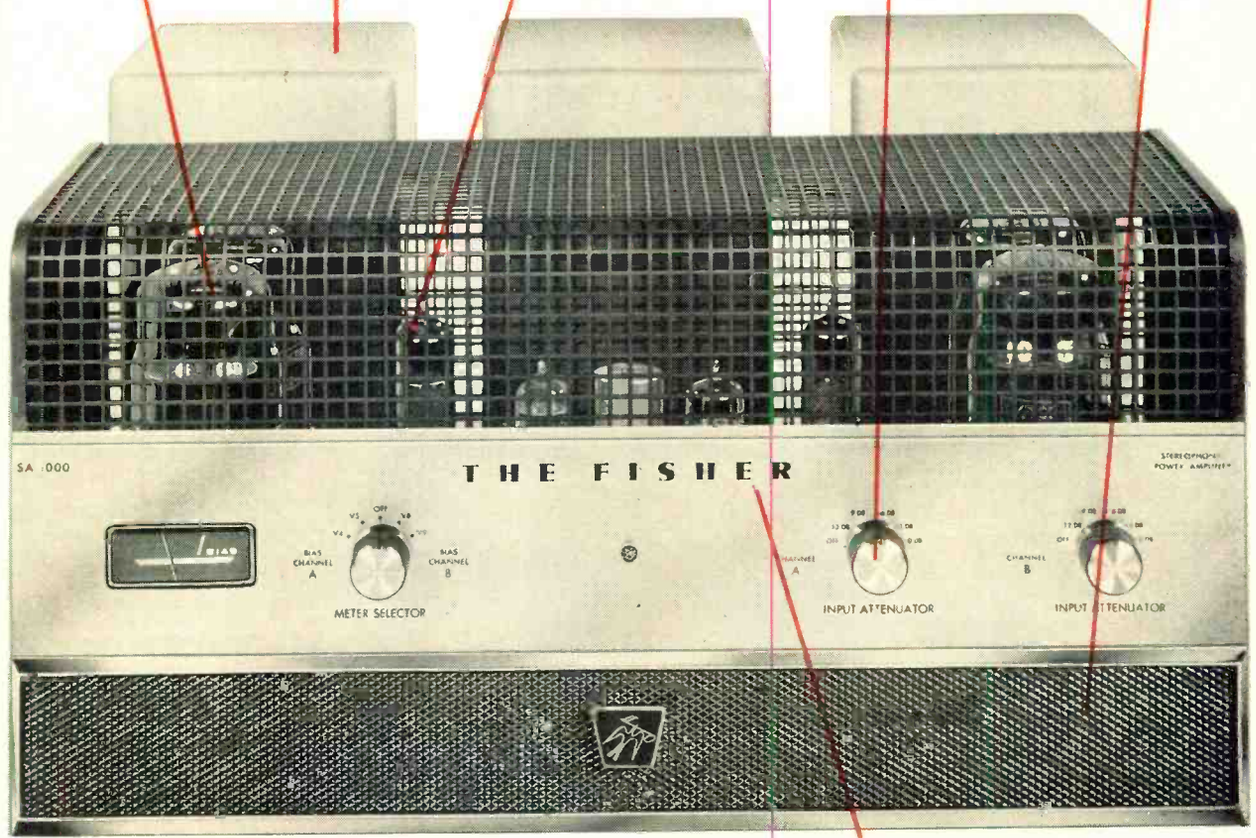


old and unique

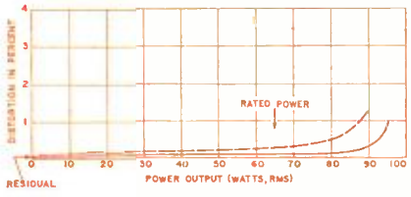
Introducing the 150-watt SA-1000 stereo power amplifier...by a maker who needs no introduction.

After more than 25 years of serving the high fidelity perfectionist's needs, Fisher still has the same policy on brand-new engineering projects: all-out or not at all. Nowhere is this uncompromising philosophy more eloquently demonstrated than in the case of the new Fisher SA-1000 stereo power amplifier.

The SA-1000 represents Fisher's first entry in the highly specialized class of extremely high-powered dual-channel basic amplifiers. There has been no scarcity of advanced equipment in this heavy-weight category; excellent high-wattage stereo power amplifiers of well-known makes have been available at prices starting in the $230-to-$270 range (for factory-wired kits) and rising all the way up to $648 (for a pair of single-channel models of very de luxe construction). What does it mean, then, when Fisher finally decides to match its own contender against such formidable competition and sets the price at $329.50?

To those who know Fisher, it can mean only one thing: Fisher has exhaustively tested, measured and evaluated all these other power amplifiers in its own laboratories and finds the SA-1000 to be distinctly superior to *all* of them, regardless of price. As for the price tag, it happens to be in the low 300's rather than the 400's or 500's solely as a result of Fisher's unusually large and technically unmatched manufacturing facilities, geared for heavy inital production in anticipation of demand.

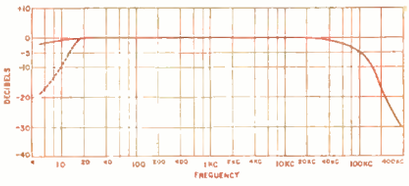
Total Harmonic Distortion at 1 kc: Solid Line
Intermodulation Distortion (60 cps/7 kc, 4:1): Dotted Line



The Fisher SA-1000 is a challenge to the severest critics and most discriminating judges of professional sound reproducing equipment, both as to specifications and listening quality. Its music power rating is 150 watts IHFM Standard, with *both* channels driven. The RMS power rating, again with both channels driven, is 130 watts (65 watts per channel). However, as a glance at the intermodulation curve will show, each channel will deliver 80 watts at 0.5% IM distortion, thus indicating the extreme conservativeness of the official rating.

The output stage of the SA-1000 is engineered around the newly developed 8417 beam power pentodes, *never before used in any electronic device*. Designed specifically for use in this amplifier, the 8417 offers extreme linearity, resulting in greatly reduced distortion, and has unusually low drive-voltage requirements, permitting the previous stages to 'coast' at their lowest possible distortion levels. The unique *cavity anode* design of the 8417 is an important factor of its superior performance characteristics.

Frequency Response (0 db = 4 watts)
Subsonic Filter: Dotted Line



Each pair of 8417's in the SA-1000 drives a giant output transformer via plate-cathode coupling — a modified and improved 'ultra-linear' configuration that provides 12 db of the most desirable and stable type of negative feedback in the output stage. The custom-wound output transformers are unlike all others in that their response rolls off below 5 cps and above 200 kc without the slightest peaks or dips. (See the frequency response curve.) This results in exceptional stability and superb square wave reproduction.

The driver stage, too, is entirely novel. A triode-connected 6UH8/ELL80 dual power pentode circuit developed by Fisher engineers is capable of delivering 40% more drive to the output stage than is required — and at a remarkably low impedance. The result is very low distortion, the fastest possible recovery time, great stability and hence outstanding transient response.

For the pre-driver and phase inverter stage, an ECC83/12AX7 dual triode is used in a DC-coupled cathodyne configuration characterized by extremely low distortion and phase shift. A feedback loop from the output transformer secondary to the pre-driver cathode provides 17 db of distortion-reducing feedback.

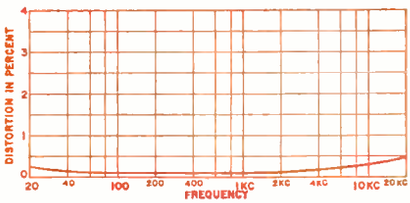
The input stage of the SA-1000 is of a type widely used in laboratory oscilloscopes but never before in high-fidelity amplifiers. A compensated input attenuator in conjunction with a cathode-follower circuit permits adjustment of the input signal from 0 db to — 12 db in closely calibrated 3 db steps without the slightest effect on input impedance and frequency response. This feature in effect provides five different input sensitivities, ranging from 0.7 to 2.75 volts (for full rated RMS output), so that the preamplifier volume control can be operated strictly within its optimum range.

A switchable subsonic filter has also been designed into the input stage, in keeping with the widely held engineering opinion that, for the majority of practical applications, response should be flat down to 20 cps only and then fall off as rapidly as possible. (See dotted part of frequency response curve.)

The power supply of the SA-1000 is one of the most elaborate ever used in a stereo power amplifier. Regulation and filtering are of the highest order and all silicon diodes as well as filter capacitors are most conservatively operated.

Bias and balance are readily adjustable on each channel by means of the built-in laboratory-type calibration meter, but the controls for these rarely needed adjustments are ingeniously concealed behind an attractive hinged cover — another Fisher exclusive.

Total Harmonic Distortion (One Channel) at 65 watts RMS
(Note that from 20 cps to 10 kc distortion does not rise above ¼% even at maximum rated power.)



These are the most important facts and figures. You cannot fully evaluate the Fisher SA-1000, however, simply by reading about it. A comparative listening test at your dealer is an absolute must in this case. *Then* you will know that, even in this exalted category, not all power amplifiers sound exactly alike—and that the most flawless of them all costs only **$329.50.***

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HERMAN BURSTEIN*

(Note: To facilitate a prompt reply, please enclose a stamped, self-addressed envelope with your question.)

Recording FM

*Q. A short time ago I purchased a **** tape recorder. The meager information contained in the manual accompanying this machine states that there is a radio/phono input for recording directly from an FM tuner and/or phono output. However, the output from the "tape out" jack of my audio preamp is not high enough to drive the tape recorder when the preamp is driven by my FM tuner or magnetic pickup. The only signal that will drive the recorder is that from another tuner producing 1.5 volts. I wrote to the manufacturer of the tape recorder, and he advised that I take it to an official service station, which in turn informed me that the machine checked out o.k. but that since the radio/phono input is fed to one half of an ECL82 they couldn't see how it could be expected to drive the record head with the level of signal delivered by most FM tuners and preamps around today. PROBLEM: How can I make good recordings from FM broadcasts without having to take the signal from the speaker output of my amplifier and thereby include the extra circuit noise and distortion?*

A. From the information you have given me I cannot tell whether it is your audio preamp or the **** tape recorder that is at fault. A properly designed tape recorder should be able to reach full recording level on high-level input when the source is 0.5 volt or greater; many tape recorders can do so on inputs of 0.25 volt or less. Full recording level is that which produces 3 per cent harmonic distortion at 400 cps. Did the official service station inform you exactly how much voltage is required for full recording level?

If appreciably more than 0.5 volt is needed to drive the tape recorder, this suggests a defective recording stage. If the service station can't get your machine to record properly on a signal of this level, I suggest that you again contact the manufacturer or possibly your dealer.

There is a possibility that the record level indicator is incorrectly calibrated, so that you *think* you aren't reaching full recording level although actually you are. Did the service station check this possibility?

If your audio preamp is at fault because it delivers less than 0.5 volt to the tape recorder, it might be possible to connect its tape output jack to a later point in the circuit, where gain is higher.

Whether it is the audio preamp or the tape recorder that is at fault, it may be feasible to make a simple modification of the tape recorder so that a relatively small high-level signal can drive it. You state that the radio/phono input goes to one half of an ECL82. I cannot find a listing of this tube but perhaps you can substitute a higher-gain tube. If you can't substitute, it may be feasible to connect the radio/phono input jack to the tube to which the low-level (microphone) input is connected. To avoid overloading this tube, the radio/phono signal would have to go through a voltage divider. To keep the low-level and high level input sources from affecting each other, it may be feasible to connect the radio/phono input jack to the cathode of the tube instead of the grid.

Bulk Tape Eraser

*Q. I now own a **** tape recorder. Soon after I purchased it, a friend demonstarted the merits of a bulk tape eraser. These bulk erasers are handy gadgets which are both useful and expensive. Would you possibly know of any method to build one?*

A. You can construct your own bulk eraser, provided that you can obtain an old power transformer such as is found in an audio power amplifier, TV set, or transformer-operated radio. You may be able to get one from a dealer in surplus electronic merchandise, or from someone who deals in used electronic equipment. The cost should be well under five dollars, opssibly as little as a dollar or two. The transformer primary winding must be intact, and none of the other windings may be shorted, although it does not matter if any of the latter are open.

The procedure is as follows: Disassemble the transformer by removing the nuts and bolts and case. Remove the E-shaped and I-shaped plates from the transformer core, and reinsert *only* the E-plates so that they all face in the same direction. Reassemble the transformer except for the case. Attach several feet of lamp cord, terminating in a plug for the power socket, to the leads of the primary winding. Be sure that you are able to identify the primary leads before you begin construction; usually, but not always, they are black. (Perhaps I had better explain that the primary leads of a transformer are those which are meant to be connected to the power line.) Snip all other windings and tape them carefully so that they will not make contact with each other. Wind the bulk eraser, which is what you now have, with friction or rubber tape in order to protect the core and windings.

When you connect the plug to the house socket, your bulk eraser will produce a very powerful magnetic field, enough to thoroughly erase a reel of tape brought within an inch or so. (It may be a good idea to remove your wristwatch.) Erase tape by bringing the reel into immediate contact with the bulk eraser and then removing it slowly, meanwhile moving the reel in circulation fashion. Do not shut off the bulk eraser until the tape has been removed several feet. The eraser should not be operated for more than one minute at a time, because it heats up rapidly. However, within that minute you can erase several reels of tape, if need be. This bulk eraser is not suited for production line work, but is quite suitable for home use.

A Level Problem

*Q. I have some difficulty in getting my stereo system to record, and I would appreciate any advice you can give me. I have a **** stereo recorder connected to a xxxx stereo preamp for recording and playback. All of my stereo recordings show a noticeable loss of high frequencies and a small amount of distortion. I have found that this is due to having several resistors connected to the output of the preamp circuit to limit the voltage since the tape recorder's minimum signal requirements are 2 mv on input 1 and 400 mv on input 2. The preamp supplies a voltage which is too high for input 1 and too low for input 2 of the tape machine. Could you provide any suggestions for limiting the output voltage from the preamp and yet retain a well modulated signal without any distortion?*

A. Before I could attempt to answer your questions with confidence, I would have to know the following: 1. Do you have identical trouble on both channels of the tape recorder? 2. Are you presently feeding a signal into input 1 or input 2? 3. What is the exact nature of the resistor network connected to the preamp output? What is the circuit of the preamp output? 4. How long a cable is there between the preamp output and the tape recorder input?

Without this information I can only hazard the following thoughts. Distortion may be due to overloading of one or more early stages of the tape recorder. If one of these stages contains treble emphasis, there may be clipping of the treble frequencies, resulting in ultimate loss of treble response. Distortion may be taking place in the preamp due to excessive loading of the preamp output by the voltage divider network. Depending on the nature and values of the voltage divider, these values together with cable capacitance could produce treble loss.

VU Meter vs. Eye-Tube

Sir:

In the March "Tape Guides" Mr. Burstein underrated the advantages of a VU meter over the eye-tube volume indicator. The fact that the eye-tube responds to strong, brief signals is not an advantage. Actually, these indications can be quite misleading. The eye-tube responds linearly to the applied voltage, and therefore does not give a true indication of what will be heard when playing the tape. The VU meter, on the other hand, responds logarithmically and consequently gives a much more useful indication of volume.

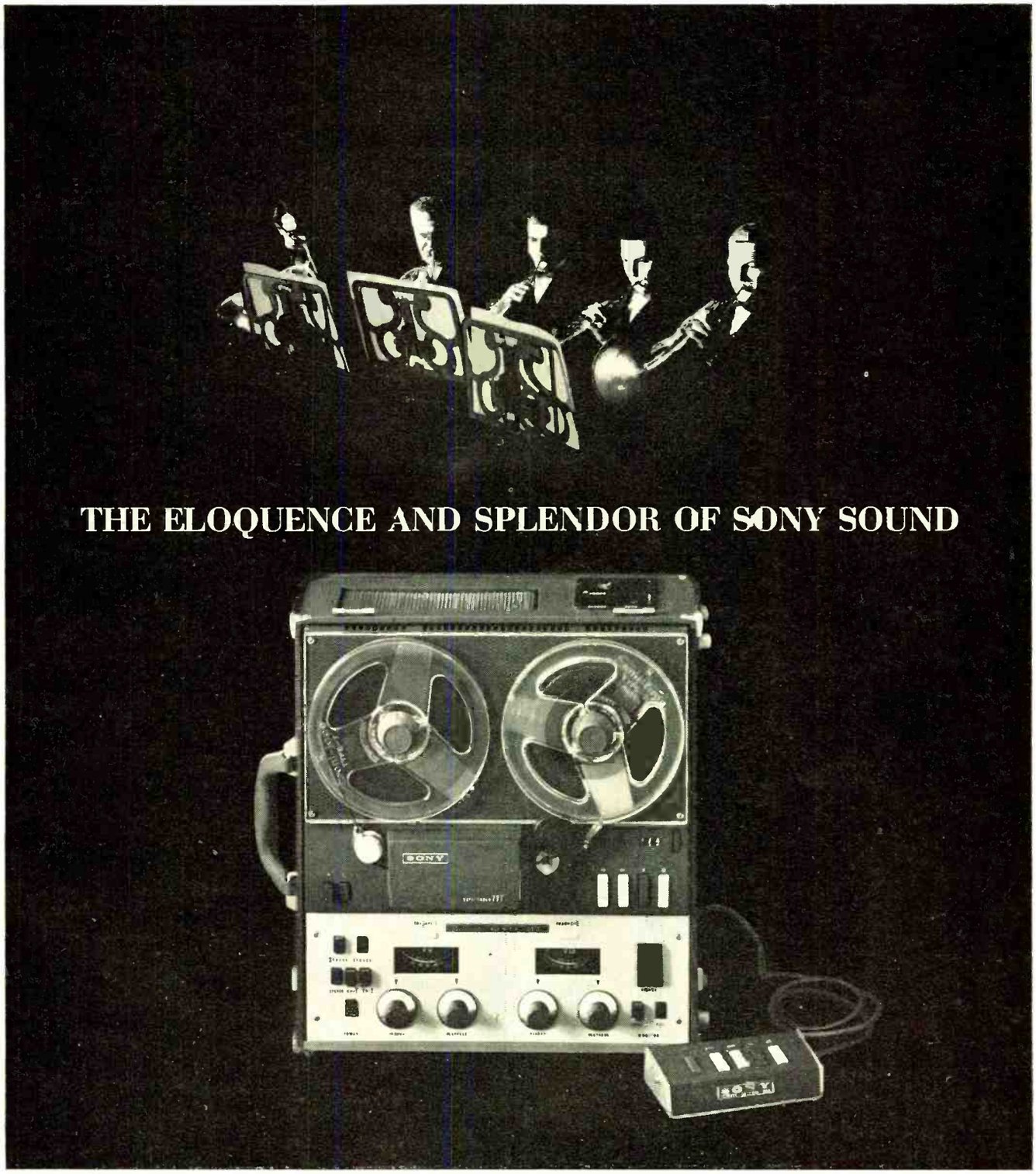
BERNARD P. ALLEN,
115-90 224th Street
Cambria Heights, N. Y.

The Address of Perfection

Q. What is the address of the Perfection Mica Co. (they make Co-netic shields)?

A. 1322 N. Elston Avenue, Chicago 22, Illinois. Æ

* *280 Twin Lane E., Wantagh, N. Y.*



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A 78-rpm Stereo Record[1]

ALLAN R. KESKINEN*

Oscilloscopic display of important characteristics permit instantaneous evaluation of a stereo cartridge.

THE ESSENTIAL CHARACTERISTICS for which a stereo cartridge must be examined are: Output level, channel balance, electrical phasing, crosstalk at 1000 cps, frequency response, and tracking ability at a given stylus force. The recording I will describe provides the user with these measurements in a visual as well as quantitative form.

The Record Design

In the preparation of this record, the 78.26-rpm standard record speed was chosen in order to reduce stylus-tracing-geometry and wavelength effects. The resulting long wavelengths, and the large groove size used, reduce tracing distortion to a minimum and extend record life. The bottom of the groove has a radius of approximately 0.0002 in. permitting use of styli as small as 0.0005 in. without danger of "bottoming."

The recording material has 10 bands arranged to permit rapid evaluation of cartridge characteristics. The time duration of each band is ample to permit accurate observation on each respective band. Bands 1, 2, and 3, as well as bands 4 to 9, are cut with a lead groove from band to band to permit continuous operation through these sections if desired.

Instrumentation and Circuitry

The instrumentation and circuitry used are important for rapid and accurate evaluation of the results available from the record.

* *Chief Engineer, Elect. Div., The Astatic Corp., Conneaut, Ohio.*

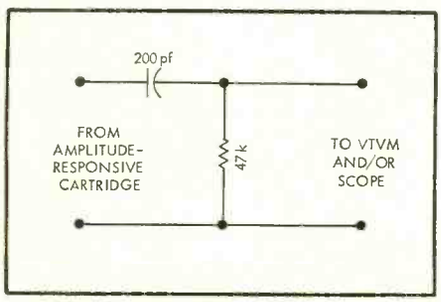

Fig. 1. Differentiating circuit.

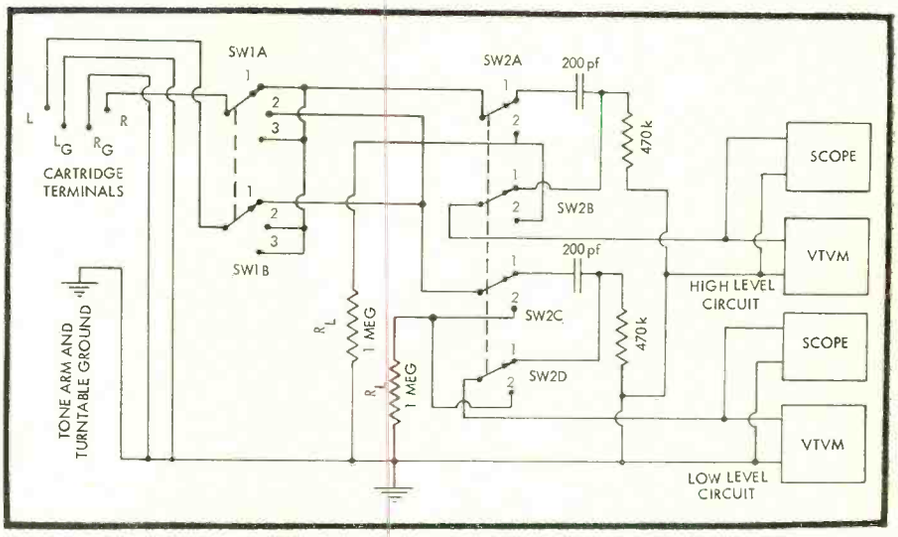

Fig. 2. Switching circuit.

This test record was recorded at a constant peak velocity throughout each band. The output of an ideal velocity-responsive cartridge should be constant throughout each band. The output of an amplitude-responsive cartridge should fall at the rate of 6 db/octave with increasing frequency. In order to produce a constant voltage throughout each band with an amplitude-responsive cartridge, it is necessary to differentiate the output. A typical circuit is shown in *Fig.* 1. A valuable feature of the differentiating circuit is its discrimination against low frequencies. This characteristic is used with the amplitude-responsive cartridge to discriminate against spurious low-frequency effects such as turntable rumble and tonearm resonance. This discrimination permits low-voltage high-frequency measurements, such as are required for measuring interchannel crosstalk, without "masking" due to the spurious low-frequency effects.

When testing velocity-responsive cartridges, the cartridge should be terminated in its recommended load for all tests. When testing amplitude-responsive cartridges, the manufacturers' specified load resistor (usually one megohm) should be used for output-voltage, channel-balance, and electrical phasing measurements. All other tests provided on this record, when testing amplitude-responsive cartridges, should be made without the load resistor but with a differentiating circuit.

In order to use this record most effectively for very rapid evaluation, in a circuit such as shown in *Fig.* 2, it is recommended that two vacuum-tube voltmeters and two oscilloscopes be used. This ar-

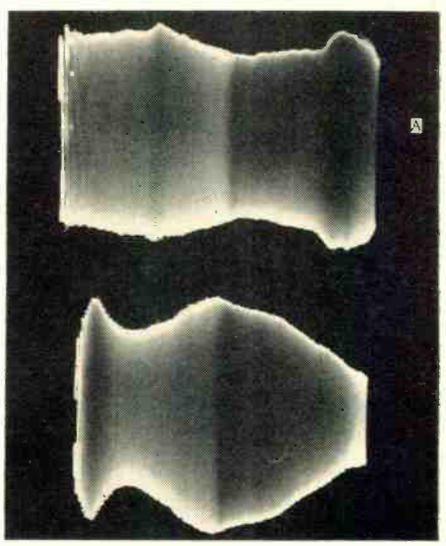

Fig. 3. Frequency-response envelope: (A) of a typical cartridge; (B) showing reduced high-frequency response.

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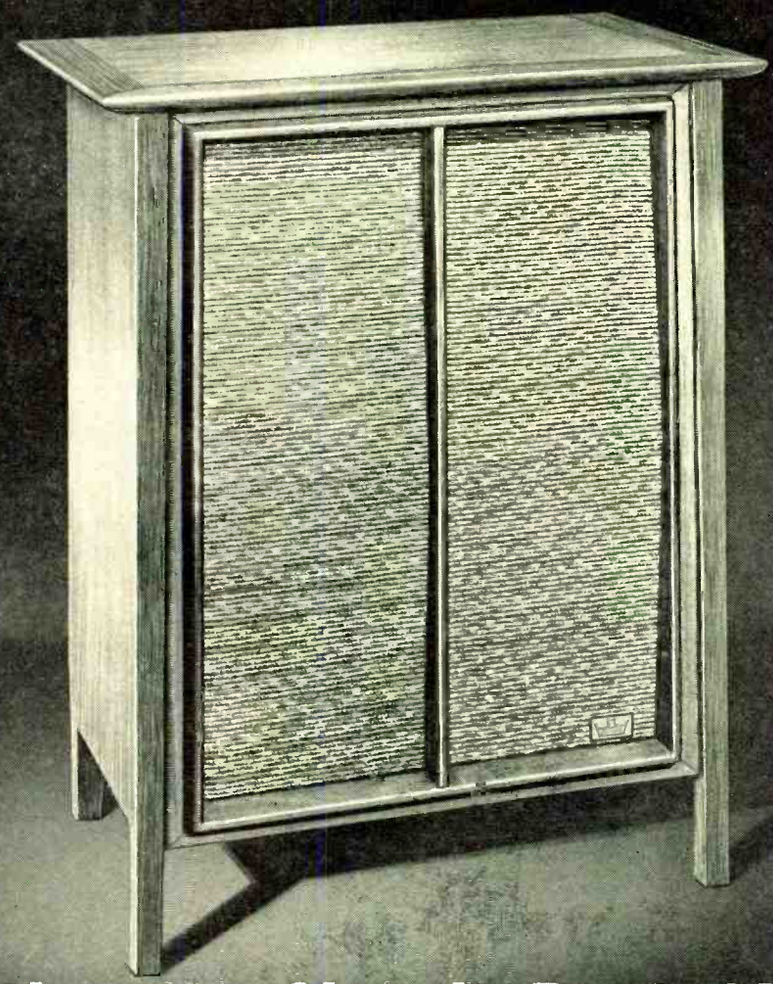

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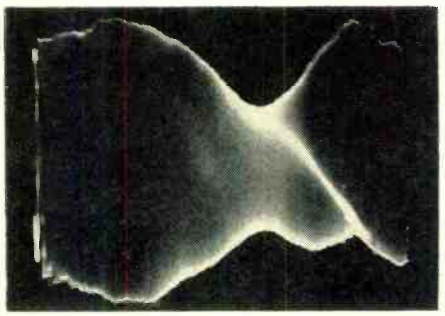


Fig. 4. Frequency-response envelope with high-frequency mistracking.

rangement permits maximum utility with a minimum of range switching. The instruments in the "High-Level Circuit" are switched to the ranges used for normal output levels. The instruments in the "Low-Level Circuit" are switched to ranges appropriate for measurement of crosstalk voltages.

In the circuit of *Fig.* 2, SW_1 is used to provide the cartridge terminal selection for the particular measurements available from various bands. Position 1 connects the right-channel cartridge terminals to the "High-Level Circuit" vacuum-tube voltmeter and oscilloscope. The left-channel terminals are connected to the "Low-Level Circuit." Position 2 connects the left-channel terminals to the "High-Level Circuits" and the right-channel terminals to the "Low-Level Circuits." Position 3 connects both channels in parallel to the "High-Level Circuits." SW_2 is used to provide the selection between load and differentiating circuit along with switching instrumentation to the particular circuit selected. Position 1 connects the differentiating circuit to the cartridge terminals. The instrumentation is connected to this circuit output. Position 2 connects the recommended load resistance to the cartridge terminals and the "High-Level" instrumentation across this load resistance.

Application Theory and Practice

Band 1 is a lateral 1000-cps recording at 7 cm/sec. The groove modulation is parallel to the surface of the disc. A recording made at 7 cm/sec in the lateral direction results in each wall of the groove being modulated 5 cm/sec perpendicular to each of the respective 45-deg. groove wall directions. The result from this accurately cut groove is a well balanced stereo signal with the sum (L + R) only components. The output measured from each stereo channel is the output of a 5 cm/sec stereo channel. The L and R components are not only balanced in amplitude but are accurately in phase.

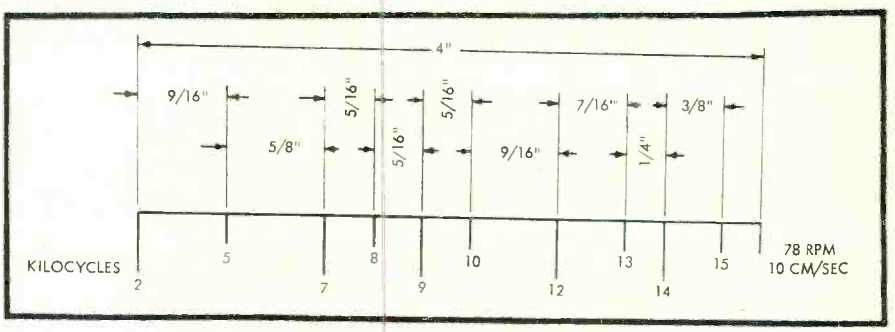


Fig. 6. Frequency calibration chart.

Assuming the circuitry of *Fig.* 2 is used to test a stereo cartridge on Band 1, SW_2 should be in position 2 to terminate the cartridge in its recommended load. Switching SW_1 between positions 1 and 2 alternately connects left- and right-channel terminals to the "High-Level Circuit" to measure left- and right-channel outputs for level and channel balance. Since the two channels are in phase mechanically, operating SW_1 to position 3 to parallel the two outputs, results in approximately normal output for electrically "in phase" signals. "Out of phase" connection results in voltage cancellation and is indicated by a greatly reduced output level.

Band 2 is a right-channel-only 45-deg. stereo recording at 5 cm/sec with left-channel residual (crosstalk) more than 35-db below the recorded channel.

Band 3 is a left-channel-only 45-deg. stereo recording at 5 cm/sec with right-channel residual (crosstalk) more than 35-db below the recorded channel.

Bands 2 and 3 provide the respective output-level information and also permit crosstalk measurements. Velocity-responsive cartridges may be measured with the recommended load resistor but crosstalk of amplitude-responsive cartridges should be measured with the differentiating circuit connected (SW_2 in position 1) to reduce the effect of low-frequency disturbances "masking" the crosstalk voltmeter readings. SW_1 position 1 on Band 2 permits reading right-channel output on the "High-Level Circuit" and crosstalk on the "Low-Level Circuit." Similarly, on Band 3, SW_1 position 2 permits reading left-channel output on the "High-Level Circuit" and crosstalk on the "Low-Level Circuit." In each instance the ratio of the "High-Level" voltmeter indication to that of the "Low-Level" voltmeter, expressed in decibels, is the crosstalk ratio. On both Bands 2 and 3 oscilloscopic observation of the voltages being measured is an aid in identifying the nature of the "Low-Level" signal being measured. Experience will enable the tester to identify actual crosstalk voltages as compared to possible spurious voltages which may be present.

Band 4 is a laterally-recorded swept-frequency band 2000 to 15,000 cps, at a constant 10 cm/sec. The lateral recording provides equal outputs on both the left and right channels. The constant velocity provides constant output voltage over the spectrum with velocity-responsive cartridges. Use of the differentiating circuit provides a constant output voltage, over the spectrum covered, with amplitude-responsive cartridges. A sharp large-am-

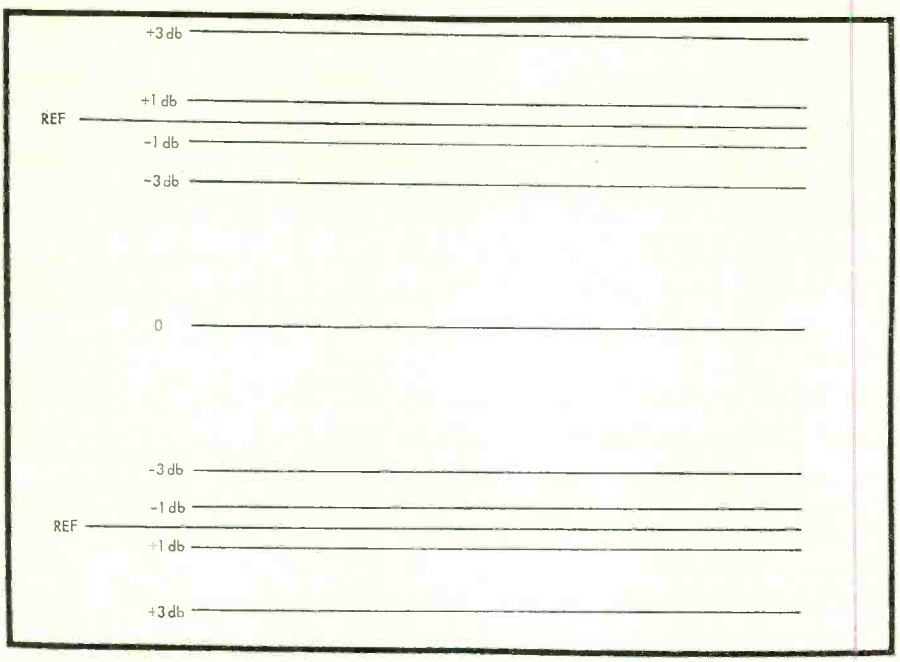
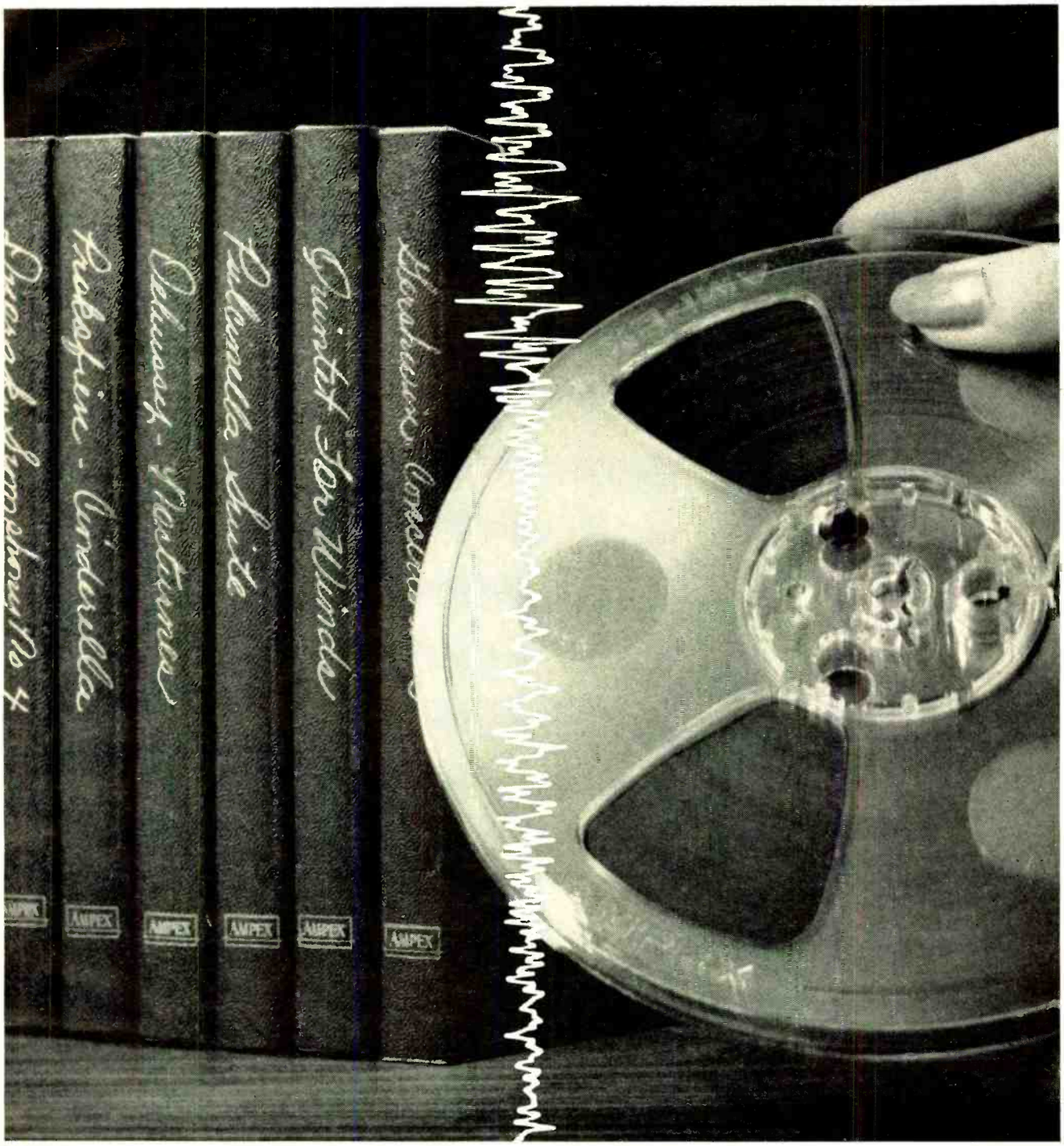


Fig. 5. Amplitude calibration chart.



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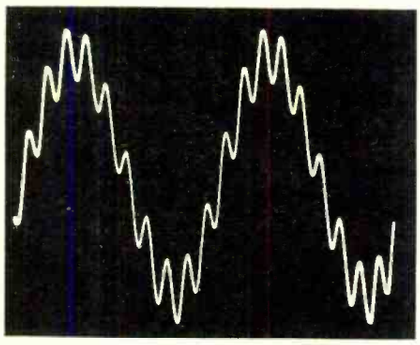


Fig. 7. Trace of recorded bands 5 to 9 inclusive.

plitude pulse is provided at the start of each sweep (approximately 28-cps repetition rate) to aid oscilloscope synchronization. Operation of SW_1 again permits selection of the channel to be observed on the oscilloscope. Additional differentiation of the synchronizing pulse by means of a small capacitor into the external synch input of some oscilloscopes is an aid in obtaining synchronization for stable presentation. *Figure* 3 is a photograph of a typical oscilloscopic presentation.[2] Deviations from a constant vertical deflection indicate deviations from "flat" response. It is important to note the effect, shown in *Fig.* 4, of mistracking effects in the higher frequencies. These effects, visible as a shading in the high-frequency portion of the photograph, are due to insufficient stylus force, worn stylus tip, resonance due to low compliance, or excessive stylus-tip mass, and incorrect damping.

Convenient scales have been prepared to aid in direct measurements from the oscilloscope screen. *Figure* 5 is a calibration chart for amplitude measurements. If the oscilloscope vertical gain is set to present normal output envelope at the reference lines, deviations from the reference lines represent output deviations from "flat" response as indicated by the plus and minus calibration lines. *Figure* 6 is a frequency calibration chart when the oscilloscope horizontal gain is set to a 4-in. horizontal length. The lower frequencies have not been included in the swept range because the record was designed for measurement of cartridge characteristics. In the low-frequency, range, the effect of cartridge characteristics is completely dependent upon characteristics of associated equipment such as the tone arm. The high-frequency display provided by Band 4 compares cartridge characteristics which are meaningful in terms of frequency response and high-frequency mistracking effects due to insufficient stylus force, defective stylus tips, excessive stylus-tip mass, low compliance, mechanical non-linearities, and improper damping materials.

Bands 5 to 9, inclusive, are combined 400 and 4000-cps lateral recording with the 4000 cps recorded 12 db below the 400-cps level at various peak velocities, Band 5 is 25 cm/sec, Band 6 is 17.7 cm/sec, Band 7 is 12.5 cm/sec, Band 8 is 8.8 cm/sec, and Band 9 is 6.25 cm/sec.

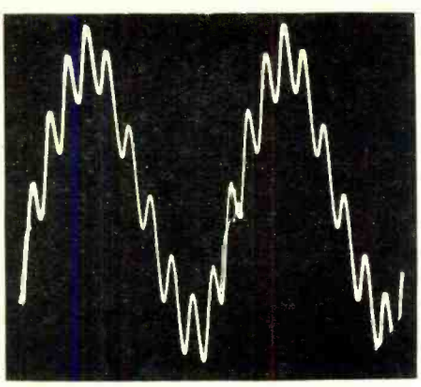


Fig. 8. Mistracking bands 5 through 9.

Each band is a recording similar to the combined signal for intermodulation distortion measurement. *Figure* 7 is an oscilloscopic trace showing the nature of the recorded signals. Use of the differentiating circuit with an amplitude-responsive cartridge maintains the proper ratio between the 400- and 4000-cps velocities. Failure to track will appear at the maximum acceleration position on the recorded pattern. This method is very sensitive in displaying mistracking effects. A cartridge which tracks well on one band but does not track in the next higher acceleration band produces a readily observed display on the oscilloscope. *Figure* 8 is an oscilloscopic presentation showing mistracking effects. This closely follows the method described by H. E. Roys.[3] The velocities specified are the resulting peaks of the combined 400- and 4000-cps sine waves with the 4000 cps 12 db below the 400-cps level. The combined signal can be used with intermodulation distortion meters for measurement of intermodulation distortion. The oscilloscope presentation clearly indicates the degree of mistracking at any particular stylus force at any of the recorded velocities.

This test is based on performance of the cartridge under test in the portion of the frequency spectrum where recorded amplitudes (and velocities) of groove modulation are the greatest that may be encountered (due to space limitation between grooves). It combines the effects of compliance as measured by the method described by B. B. Bauer[4] with effects of dynamic mass at the stylus tip at high accelerations.

Band 10 is a 1000-cps lateral recording at 5.5 cm/sec. This recording level has long been used as a reference standard in lateral recording.

Figure 9 is a photograph showing the record-cutting lathe with a tilted cutting head used to produce the master disc with only one channel of a 45-deg. stereo test signal. This method of cutting the groove provided a means of carefully adjusting the modulation angle to result in a minimum recorded modulation on the unmodulated groove wall for crosstalk measurement purposes. Æ

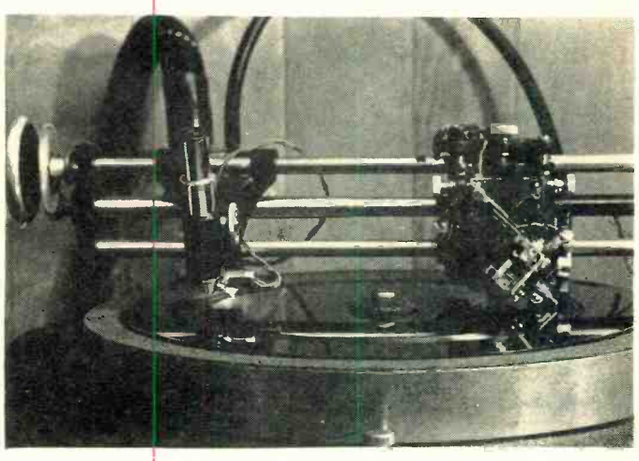


Fig. 9. Cutting lathe showing tilted cutting head.

NOTES

[1] Presented at the 14th Annual Convention of the Audio Engineering Society.

[2] Johnson, W. R.; "Analyzing sweep-frequency transcriptions," AUDIO ENGINEERING, Oct. 1947; pp. 18–19.

[3] Roys, H. E.; "Analysis of tracing distortion by two-frequency method," *R.C.A. Review;* June 1949; pp. 254–269.

[4] Bauer, B. B., "Measurement of mechanical compliance and damping of phonograph pickups," *J. Acous. Soc. Am.*, March 1947; pp. 319–321.

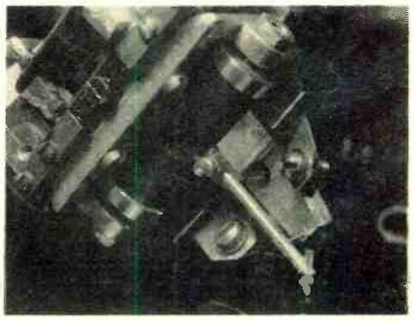
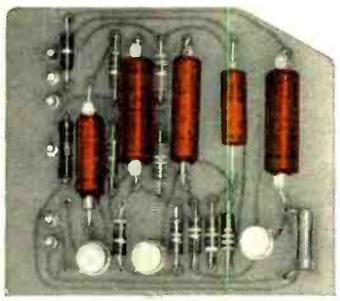


Fig. 10. Detail of tilted cutting head.



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EQUIPMENT REPORT — HIGH FIDELITY MAGAZINE

For the full text of the High Fidelity report, write Dept. A-4, Citation Division, Harman-Kardon, Inc., Plainview, N. Y.

harman kardon

Sound Reinforcement at Philharmonic Hall

DAVID SASLAW

An up-to-date example of sound system design for the concert hall, and a well developed application of the loudspeaker cluster design concept.

Much ado has been made of the acoustics of Philharmonic Hall but nothing has been said about the sound reinforcement system. Perhaps this is a mute testimonial to the excellence of the design—nobody has noticed it!

Naturally it is an oversimplification to take absence of negative reaction as a positive virtue. On the other hand, the pointed critical comments about other design areas of the Hall would lead one to suspect that comment would have been made if there had been even the slightest observable fault.

Purpose of the System

The term "sound reinforcement" is rather ambiguous—it doesn't really specify what sounds are to be reinforced. We are not trying to be facetious—rather we are leading to the fact that the reinforcement system at Philharmonic Hall is required to fulfill several functions other than "public address." Precisely, the system is required to:

1. Provide speech reinforcement so that a person talking on stage can be heard clearly at any seat.
2. Provide reinforcement for small music groups or soloists as required.
3. Permit recording or broadcasting while providing sound reinforcement.
4. Provide monophonic playback of recorded material including motion picture sound.

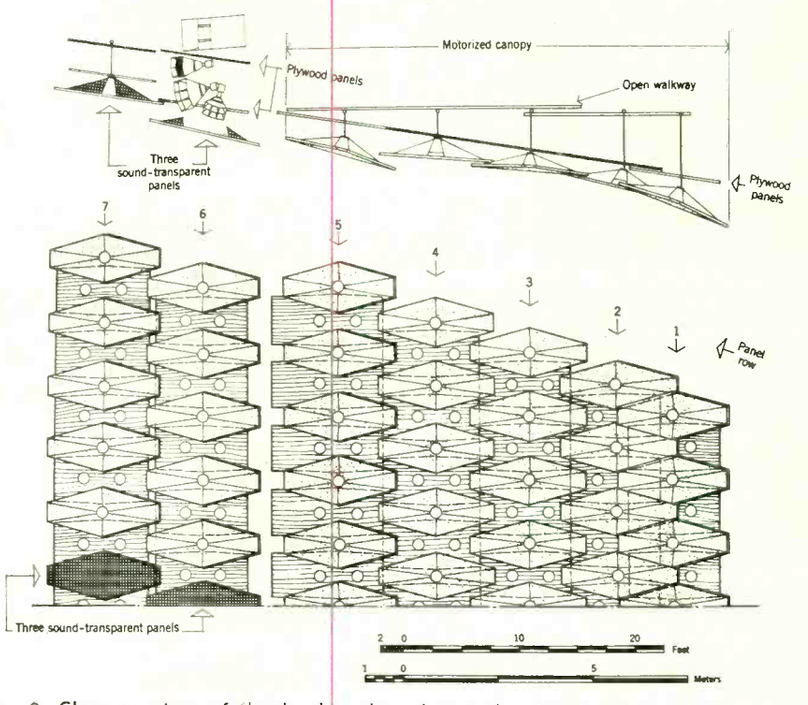


Fig. 2. Close-up view of the loudspeaker cluster showing location relative to the motorized stage "clouds." (Drawing from "Music, Acoustics, and Architecture," by L. Beranek.)

5. Provide loudspeaker coverage, in various specified places, of activities taking place within the Hall.

That's both a tall order and a strange-sounding one. The strangeness comes from the requirement to reinforce some types of musical performance in a concert hall. This highlights the fact that some types of instruments, or combinations, project better when amplified (in a hall as large as this one). But projecting music requires that the system be relatively wide range with low distortion; as opposed to speech reinforcement which has the goal of improved intelligibility, usually accomplished with a narrower bandwidth. That's where the tall part comes in; making a system to satisfy both requirements, and well.

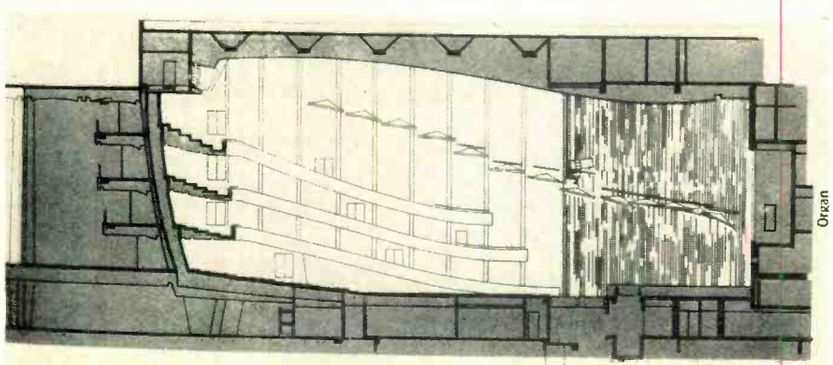
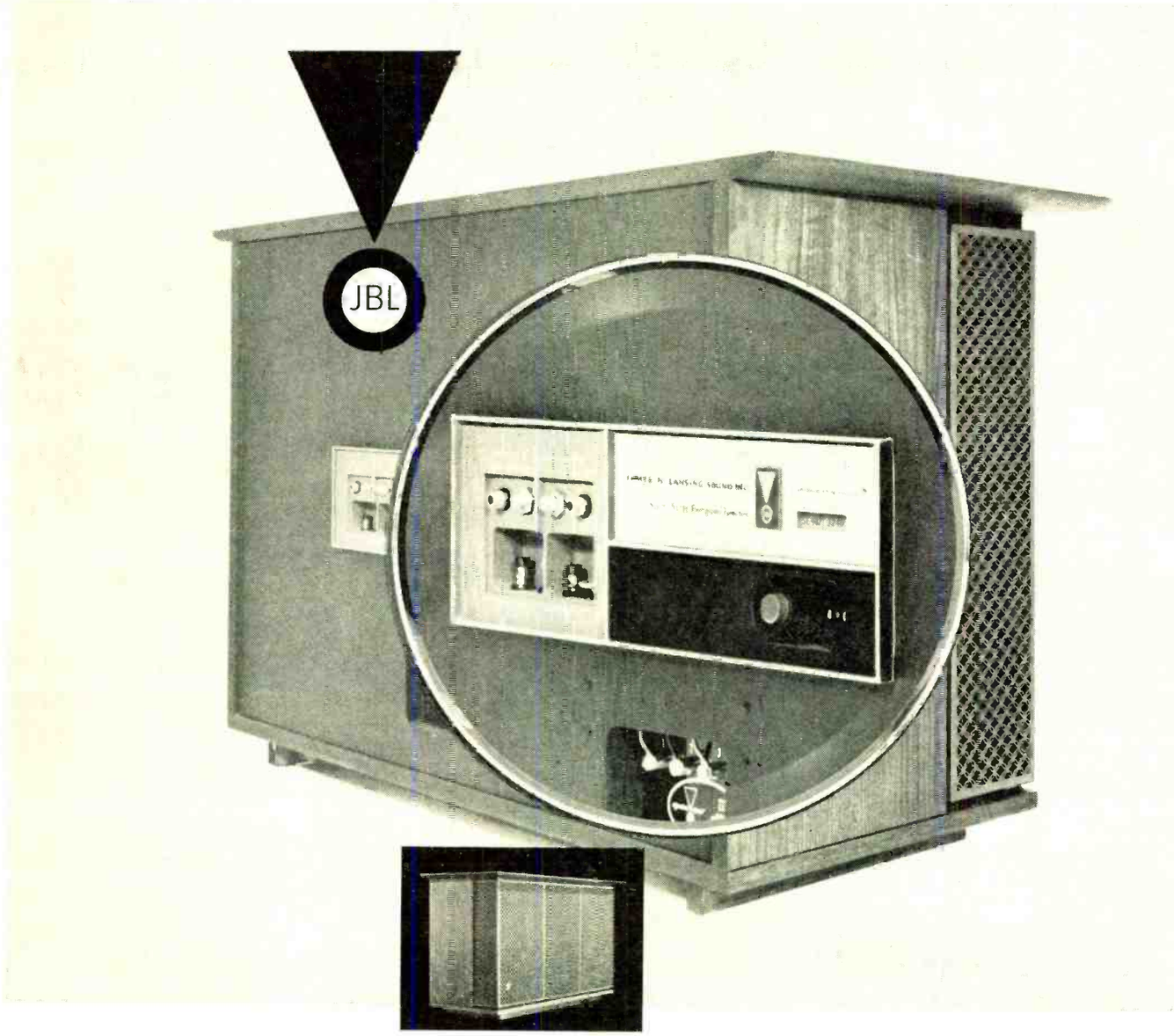


Fig. 1. Side view of Philharmonic Hall showing location of "clouds" and loudspeaker cluster. Note the sound room located above the clouds in the rear of the Hall. (Drawing from "Music, Acoustics, and Architecture," by L. Beranek.)

Multiple-Function Solution

At the input side of the system the way this problem was handled at Philharmonic Hall was to roll off the frequencies below 300 cps by means of a filter for the speech function, and use high-quality condenser microphones for the music reinforcement and recording functions. Recognizably, this is a time-



JBL PRESENTS THE SOLID STATE ***ENERGIZER/TRANSDUCER***

With the Energizer/Transducer, JBL brings you another giant stride closer to perfect audio realism. Now you can have a JBL precision transducer with its own built-in power mate. By engineering the transducers, power source, and enclosure as an indivisible entity, the designers have complete control over every facet of the reproduction system. They have discretion over any band of frequencies, can govern the size and shape of a single cycle if they so will. Consequently, in the JBL Energizer/Transducer the amplified signal is precisely tailored to the requirements of the entire system. The music you hear is the most exact replica of the original performance yet achieved. Built entirely of solid state devices, the energizer is devoid of microphonics, produces negligible heat, and therefore can be mounted within the acoustical enclosure. Due to their tight electrical and mechanical coupling, JBL transducers reproduce the steepest musical wave fronts with an accuracy, alacrity, and facility that is unique among loudspeakers. The energizer has the ability to amplify square waves perfectly. The combination of these two features results in system transient response that has never been equalled. Hum is extinguished. Distortion in any form approaches the vanishing point. Frequency response is flat. Sound pressure reserves are available that you will never use even in your most avid listening sessions. Initially, JBL self-powered loudspeakers are offered in E/T Olympus, E/T Apollo, and E/T Lancer 66 models. Telephone the JBL Franchised Audio Specialist in your community; arrange for a protracted audition; be sure to compare what you hear with conventional loudspeaker and amplifier systems. Write for complete information.

JAMES B. LANSING SOUND, INC., LOS ANGELES 39, CALIFORNIA

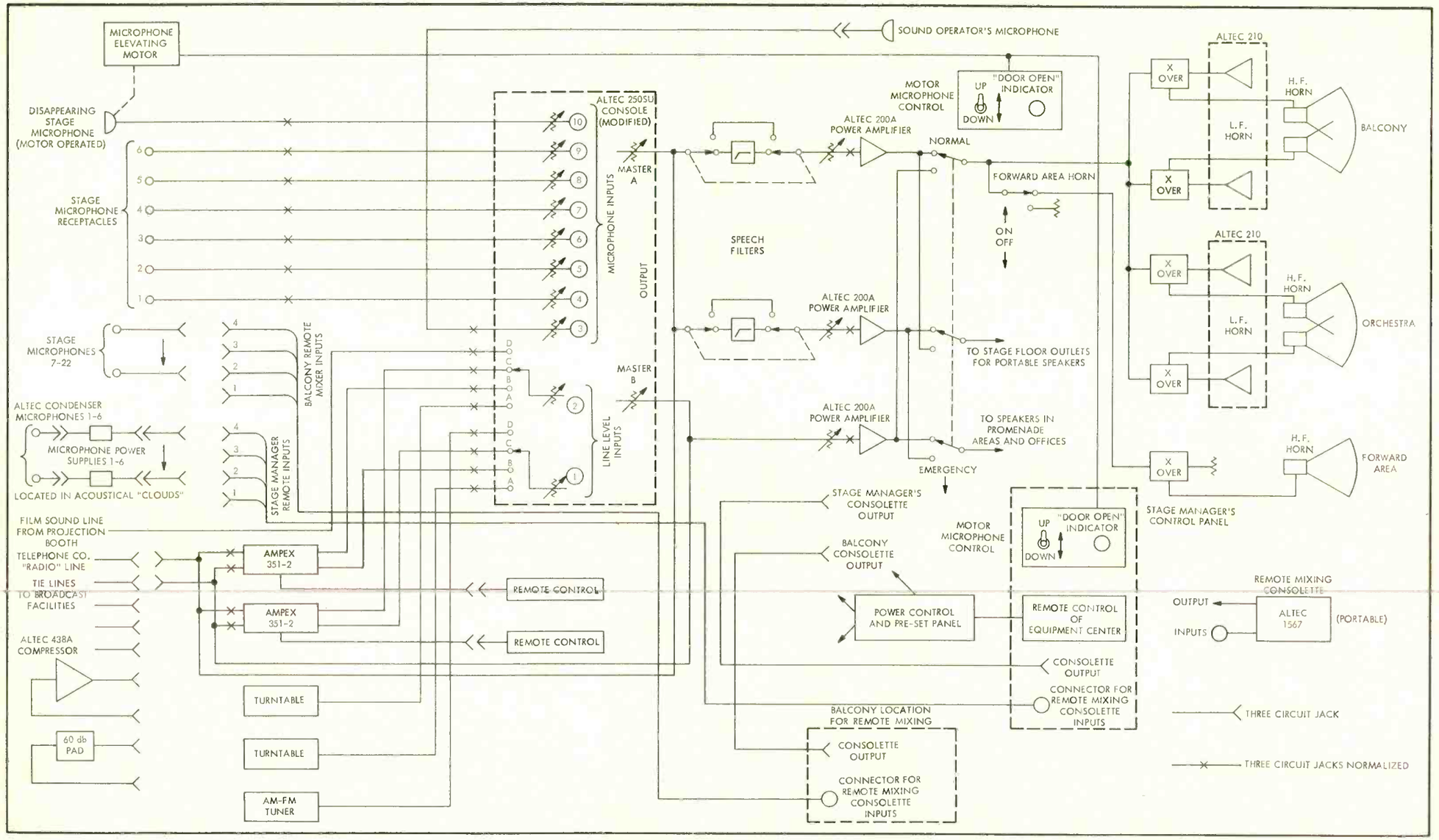
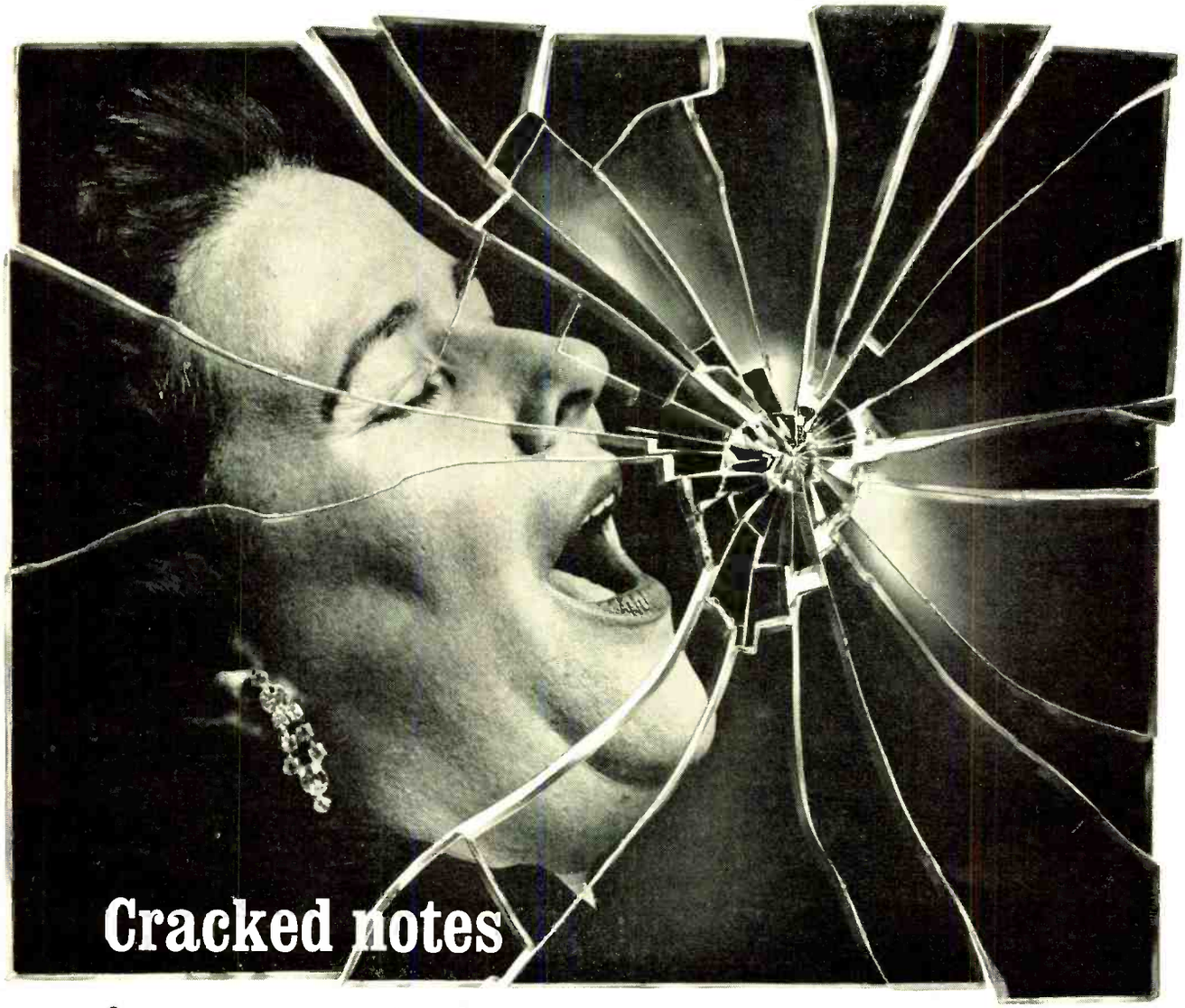


Fig. 3. Block diagram of system used at Philharmonic Hall. Note the remote consolette. This remote location is an absolute necessity in order to monitor the sound system properly. As mentioned in the text, the system is designed to "miss" the walls in order to avoid adding additional reverberation to an already live hall. Therefore, the sound system cannot be heard in the sound room. The operator thus uses a remote consolette at a special balcony location. Wiring and other facilities are available at this location and all he need do is plug in. Note also that a remote consolette can be located at the stage manager's location just offstage near the lighting console. The block diagram indicates the installation of tape recorders, turntables, and a tuner which are not yet installed.

(*Continued on page 54*)



in your aria?

...then "bargain" recording tape's no bargain!

Trouble with cheap tape with an unknown name is simply this: You can't *see* much difference between it and fine-quality tape. But you sure *hear* the difference when tiny imperfections are magnified into shattered sound . . . a danger greater than ever with today's four-track stereo, where each track of recording takes less than a quarter of the tape's width.

Surest way to record sound crystal clear, enjoy maximum performance from your equipment is to rely on "SCOTCH" BRAND Recording Tapes. They are required by 3M to pass more than 100 quality tests to ensure inch-after-inch uniformity. Result: identical recording characteristics—full frequency sensitivity, wide dynamic range—throughout each reel, reel after reel.

High potency oxides in "SCOTCH" Recording Tapes make possible thinner, more flexible coatings that assure intimate head-to-tape contact for sharp resolution. Exclusive Silicone lubrication that lasts the life of the tape assures smooth tape travel. It protects against recorder head wear, extends tape life. So for genuine "money's worth" in performance, step up to the tape professionals prefer: "SCOTCH" BRAND.

On SCOTCH® BRAND Recording Tape, you hear it crystal clear!

Another Transistorized A. F. Voltmeter—and How to Use It

C. G. McPROUD

Many of us build devices just for the joy of building, but this instrument is practical and modernizes a popular meter of some years ago. Suggestions for the use of the meter for several types of measurements are given in a form which uses a minimum of other instruments.

WHEN WE FIRST READ the Schotz article starting on page 19 of this issue, we were strongly tempted to order the parts immediately to build one, since (1) we are a confirmed experimenter, and (2) we recognize the advantages of a transistorized instrument. A little further thinking, however, led us along another track, signalled by the existence in our equipment archives of a venerable Heathkit AV-1 a.f. voltmeter, and by the further urge not to spend any money unnecessarily until after April 15.

The AV-1 was the earliest Heathkit a.f. voltmeter to appear on the market—we have long since graduated to the IM-21, which is a much more stable and accurate instrument, and in addition we use the old, and discontinued, motorized Knightkit a.f. voltmeter, which is our "standard." However, inasmuch as the Schotz instrument required a meter, a case, multiplier resistors, and a few similar odds and ends, all of which were present in the AV-1, we elected to employ the circuitry of the Schotz unit, along with the case, meter, resistors, and the other usable bits and pieces, and make another version of the instrument.

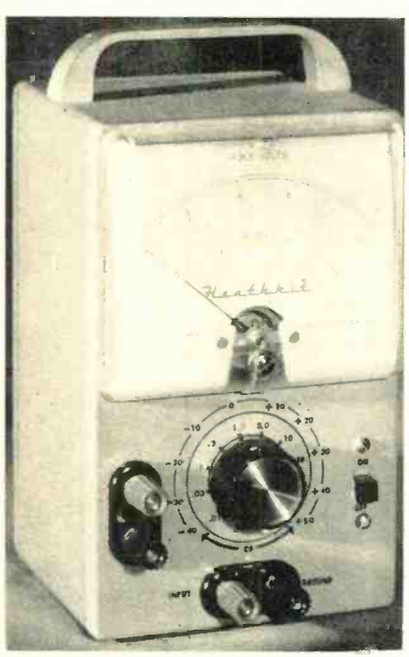


Fig. 1. External view of the Heathkit AV-1 a.f. voltmeter after modification.

To begin with, there are a few minor differences in the available parts—the Schotz instrument uses separate scales for both volts and db, whereas the AV-1 uses a single db scale. This is possible because the AV-1 is based on exactly 10 db difference between scales, resulting in voltage scales of 10 and 3.16 units at full scale. Schotz used full scales of exactly 10 and exactly 3, which differs slightly from 10 db per range, and thus requires the separate db scales.

Secondly, we are addicted to the use of printed circuit boards for construction of this type, even for a single unit. Consequently, we planned a printed circuit panel which would attach to the terminals of the meter and to one of the assembly screws of the selector switch. For the first (and only one constructed, so far) unit, we laid out the circuit with the plastic tape and plastic circles available from Techniques, Inc. for this purpose, using a piece of 1/16-in. laminate. After the circuit was laid out entirely, we etched it in the solution provided. From experience, we have learned that the etching operation is speeded up by heating the solution, and we regularly use a Pyrex pie plate on top of a conventional gas kitchen stove for the purpose, heating the solution up to around 180 deg.

Input Circuit Differences

Because of the differences between the scales, the resistances of the input circuits of the two instruments differ slightly. The modified AV-1 input circuit is shown in *Fig.* 2. The five resistors marked with an asterisk are already used in the AV-1; the 1.0-meg resistor R_3 can be any 1-meg resistor, since the final calibration can be done by selection of a 3000-ohm resistor for R_1, as long as some accurate means of calibrating is available. One method will be described. Because of the change due to scales, R_2 is not required.

The AV-1 has an ON-OFF switch on the panel; in addition, there is a large pilot light fixture on the panel. Thus we have eliminated the OFF position on the selector switch, using a switch with eleven positions, Centralab 1009, but still with three decks. *Figure* 3 shows the rear view of the modified instrument, with the printed circuit panel in place. The adjustable capacitor C_2 mounts, effectively, from the "hot" input terminal to the strapped section of the switch covering the ranges from 3 to 300 volts; C_3 and R_1 mount from this same strapped section to the ground input terminal. We connected C_{10} from the cold side of the on-off switch to the input ground terminal, while C_5 was connected from a hole provided on the printed circuit panel to a soldering lug on the meter-mounting screw at the opposite corner of the panel. Another pair of binding posts and insulators was used for the output terminals; filing the hole in the

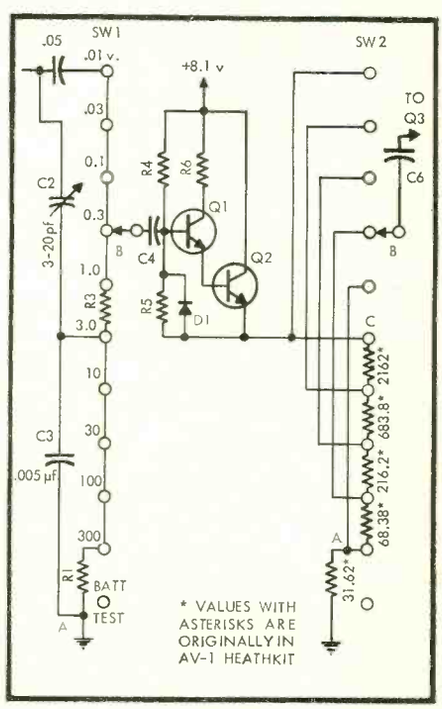


Fig. 2 Schematic of the input circuit of the modified AV-1 to show differences between this model and the over-all schematic on page 22.

'The finest FM Stereo Tuner ever built for the home'

says Martin Gersten, chief engineer of WNCN, The Concert Network

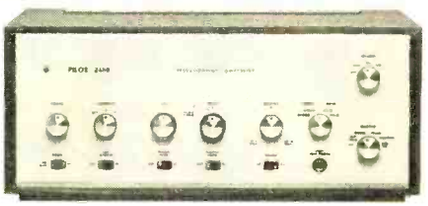
Mr. Gersten talks from experience —both as an FM broadcaster and as a high-fidelity authority and enthusiast. And in all his experience he has never heard an FM stereo tuner that compares with the PILOT 780.

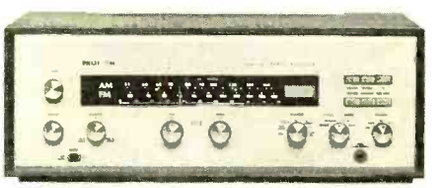
He first heard the PILOT 780 in September, 1962, at the New York High Fidelity Show.

He says: **"The Concert Network station in New York City, WNCN, 104.3, was broadcasting music and interviews with manufacturers and dealers directly from the Show. We tried to monitor our station on several FM tuners. None of them, including the most expensive ones, could produce a satisfactory signal, that is, until we walked into the PILOT exhibit and tried the 780. The exceptionally clear, noise-free signal it produced was a revelation. Subsequent tests convinced me that this was the finest FM Stereo tuner ever built for the home. Today, I use this tuner in my home and, as far as I am concerned, it is in a class by itself."**

The fact that the PILOT 780 outperforms all other tuners is no accident. Its 4 IF stages and sophisticated circuitry produce an FM Stereo performance matched only by professional broadcast monitor tuners costing hundreds of dollars more... FM sensitivity: 1.8 uv; harmonic distortion at 100% modulation: 0.2%; capture ratio: 1 db; selectivity: 44 db. Its unique signal-sampling Multiplex circuit assures at least 30 db channel separation. Its automatic FM stereo indicator takes all the guesswork out of finding stereo broadcasts. And its flywheel control construction, in conjunction with its tuning meter, assures easy, accurate tuning. At $199.50 (less enclosure), the PILOT 780 is the greatest value on the high-fidelity market today.

The PILOT 248B, companion to the 780, is a 74-watt Integrated Stereo Amplifier with a frequency response (± 1 db) of 5-50,000 cps and only 0.1% harmonic distortion (IHFM). Given an excellent rating by HiFi/Stereo Review, the 248B features outputs for tape and headphones, 7 pairs of inputs and a total of 13 front and back controls and switches. Price (less enclosure): $269.50.





For those who desire the finest receiver ever built for the home, there is no substitute for the PILOT 746, a 60-watt FM Multiplex-AM Stereo Receiver which includes many of the features of the two units mentioned above, including 8 inputs and 14 controls for complete stereo and monaural flexibility. Price (less enclosure): $399.50. For more information, hear them at your PILOT dealer, or write:

Pilot PILOT RADIO CORPORATION, 37-42 36TH STREET, LONG ISLAND CITY 1, NEW YORK

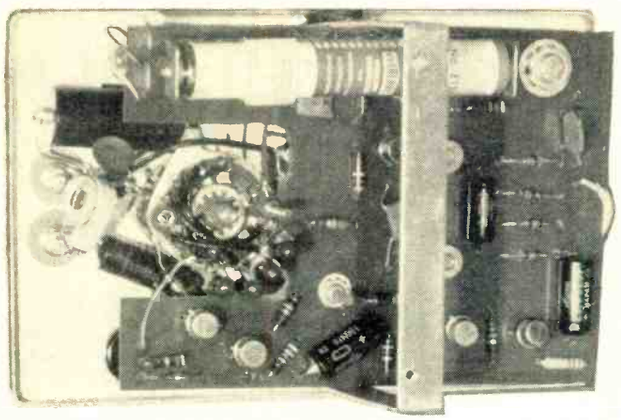


Fig. 3. Rear view of the instrument showing placement of printed circuit board and the bracket for attaching to the case.

panel provided an accurate fit for the insulators. The output terminals were connected to the printed circuit panel by a length of shielded lead, with the ground terminal connected only to the shield—and thence to the panel—and with no other ground connection being made. We thought that a capacitor should be employed between the input terminal and the first section of the switch, as shown in *Fig.* 2, so one was installed. We were unable to obtain a 1N1512 so we used a IN714, which is also a Zener diode, although of less power capacity. We chose Mallory VW-250 for R_{17}, and Mallory MLCN16A for R_{18}, since the specified types were not readily available. We also found that R_{24} should be, in our case, 47,000 ohms for an indication of "3" on the 3-volt scale with a new battery. The battery holder was mounted on ⅛-in. standoffs from the panel.

A number of holes are indicated simply with letters in *Fig.* 4, which is a full-scale drawing of the printed circuit panel. Their uses are as follows:

A ¼-in. hole for R_{18}
B ⅜-in. hole for R_{17}
C, D, E #35 drill, clearance for 3–48 screws to mount the battery holder
F ⅛-in. hole for switch assembly screw. (Check this for the switch used)
G lead to "hot" terminal on ON-OFF switch
H lead from A of Sw_3
K lead to C of Sw_2
L .05 capacitor to input terminal
M lead to B of Sw_2
N lead to input ground terminal
P lead from B of Sw_3

The 31.62-ohm resistor at the lower end of Sw_3 is connected to the lead from hole N on its way to input ground terminal.

In order to attach the front panel to the case, a bracket was made of 1/16-in. aluminum strap ½-in. wide. This bracket attaches to the two lower meter-mounting screws, and passes around the printed circuit board about ⅛-in. less in depth than the interior measurement of the case. Two holes on the rear of the bracket accommodate two sheet-metal screws from the holes in the case.

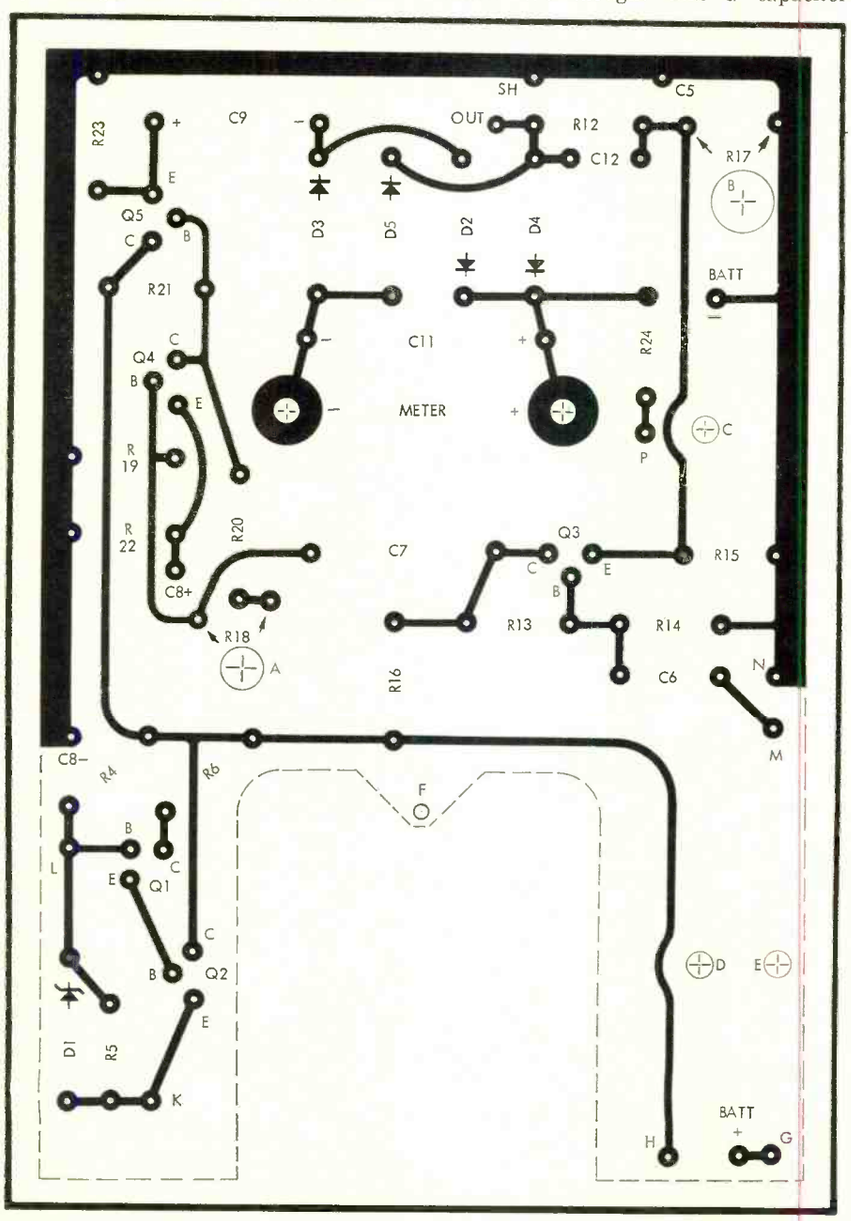


Fig. 4. Full-size diagram of printed circuit board. This may be used directly to make the board, or as a guide for parts placement on Vector board, if one is used.

The Printed Circuit Panel

While the printed circuit panel can be duplicated in a number of ways, it is not necessary that such a panel be used. As in the prototype instrument described by Schotz, a Vector circuit board can be used just as well, along with the plug-in terminals for the board. However, any photo-engraver can make the printed circuit panel from *Fig.* 4, if desired—it does not take a printed circuit specialist. It will be necessary to furnish the laminate, however, and to request that the drawing be "flopped." In making printing plates, the photo-engraver takes a piece of copy which reads correctly left-to-right and turns out a plate which *prints* correctly, but *reads* backward. If he "flops" the negative, however, the resulting plate will

(*Continued on page 66*)

NEW Jensen CALSTAR* COLUMN SPEAKERS

CALSTAR *Controlled-Angle Lobe-Suppressed Twin-Array Reproducers* are the result of an exhaustive study of directional sound radiation by Jensen engineers. In a CALSTAR column, an array of small woofers, covering the lower frequency range, is combined with a shorter array of tweeters covering the high frequency range (where the polar sharpening would otherwise become severe). Next, the signal distribution to each element is "tailored" so that the effective array length decreases as the frequency increases. The final result is a column design in which the vertical coverage angle is unusually constant for all frequencies and therefore exceptionally uniform sound quality and high speech intelligibility are achieved throughout the audience area. The exact signal distribution at each frequency provided by the pattern shaping networks has also been chosen to suppress unwanted side lobes.

Write for Specification Sheet No. CSP-114.

MODEL 55 ◀
10-Element Twin-Array
60°, 30-Watt, 8-ohm
Column Speaker
List $133

MODEL 1010 ▶
20-Element Twin-Array
30°, 60-Watt, 8-ohm
Column Speaker
List $233

*T. M.

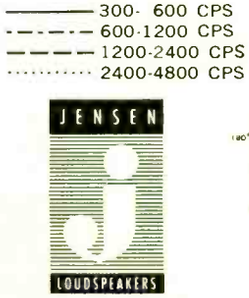
TECHNICAL SPECIFICATIONS

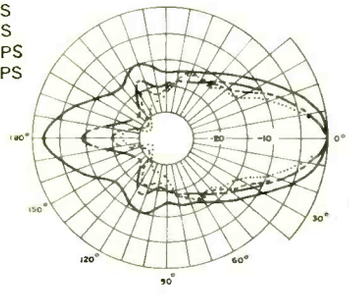
MODEL 55		MODEL 1010
8 ohms	Input Impedance	8 ohms
30 watts	Power Rating[1]	60 watts
100—10,000 cps	Frequency Range	100—10,000 cps
60° total (±30°)	Vertical Coverage	30° total (±15°)
120° total (±60°)	Horizontal Coverage	120° total (±60°)
20 db	Lobe Suppression[2]	20 db
2000 cps	Crossover Frequency	2000 cps
30"H, 11½"W, 3¾"D	Dimensions	56⅞"H, 11½"W, 3¾"D

Sensitivity Table[3]

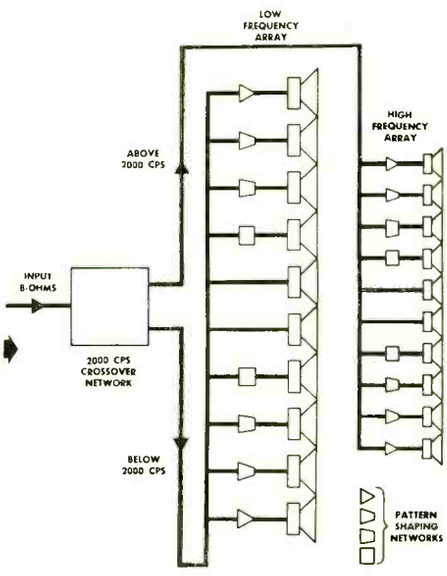
25′	50′	100′	Input Power, watts	25′	50′	100′
90.0	84.0	78.0	5	94.5	88.5	82.5
92.0	86.0	80.0	7.5	96.5	90.5	84.5
93.0	87.0	81.0	10	97.5	91.5	85.5
95.0	89.0	83.0	15	99.5	93.5	87.5
96.0	90.0	84.0	20	100.5	94.5	88.5
98.0	92.0	86.0	30	102.5	96.5	90.5
—	—	—	60	105.5	99.5	93.5

1. Maximum speech and music level as indicated by VU meter. (Peak power is substantially higher.)
2. Maximum level outside main lobe relative to main lobe intensity.
3. Axial free field sound pressure level at listed distance (db above .000204 dynes/sq. cm.) in 800-1250 cps warble frequency band.





Polar response chart shows remarkably uniform vertical coverage angle in all frequency bands.



Simplified block circuit diagram shows how input to each element is "shaped" exactly as required.

JENSEN LOUDSPEAKERS

JENSEN MANUFACTURING COMPANY/DIVISION OF THE MUTER COMPANY/6601 SOUTH LARAMIE AVENUE, CHICAGO 38, ILLINOIS
Canada: Radio Speakers of Canada, Ltd., Toronto • Argentina: UCOA, S.A., Buenos Aires • Mexico: Fapartel, S.A., Naucalpan, Mex.

EQUIPMENT PROFILE

KENWOOD KW-40 AM-FM AND FM-STEREO RECEIVER

The Kenwood KW-40 is a complete AM, FM, and FM-stereo receiving system incorporating a 40-watt (20 watts per channel) stereo amplifier and a control system adequate to handle inputs from a phono pickup (magnetic or crystal) or tape preamp, as well as supplying a signal to the tape recorder. A stereo headphone jack is located on the front panel to permit monitoring of the signal supplied to the tape recorder or just headphone listening. A full complement of controls is provided.

Inasmuch as all these functions are located on a single chassis, the KW-40 weighs in at a surprising 31 pounds. Clearly there is a lot of iron in them thar transformers, which is as it should be. It should be noted, however, that the metal cover and the chassis are unusually sturdy. That doesn't add much to performance but it does add to protection of the innards. While we are mentioning the cover, we should point out that it is finished extremely well. It seems to have a combination of smooth baked-on enamel and "crinkly" paint in two-tone brown. For looks and feel, it is certainly in the luxury category. This elegant appearance is continued on the front panel by a chrome-edged escutcheon. The only incongruous elements are the small-appearing slide-rule dial and tuning meter. Actually the dial and meter are as large as most but the relatively large surrounding area makes them appear smaller. A minor point.

In operation, the KW-40 handles well: Tuning is easy but could be more precise; controls are clearly labeled and well placed; the headphone jack is on the front panel where it should be. In its price category, the low $200's, the KW-40 offers a great deal.

An unusual feature of the KW-40 is its method of determining the transmission of an FM-stereo broadcast. It is simplicity itself. One merely sets the selector switch to the FM Sub position, tunes across the dial, and when a station is heard, switch over to the FM-Stereo position; that station is broadcasting in stereo! How does the KW-40 know? Well, in the FM Sub position you are listening to the stereo subchannel, which means that the station *must* be broadcasting in stereo. Certainly as positive and simple a system for detecting the presence of an FM-stereo broadcast as any. It is far more positive and simple in concept than those systems which indicate stereo by the presence of the 19,000-cps pilot signal. Often, these systems are triggered by "noise" or the audio signal itself. With the KW-40 system, even though noise is present, one can tell immediately that there is actually a program being transmitted, too. The cleverest part of this system is the startling simplicity by which it is achieved; all they do is ground out the main (sum) channel so that only the subchannel (difference) can get through if it is present. How's about that for intelligent designing!

Circuit Description

The FM section of the KW-40 is a rather straightforward example of tube engineering, exemplifying good design practice in its quality range. Expanding on this, it is quite obvious that this receiver is intended to fit a particular category; not the top but certainly closer to the upper levels. For example, the FM front end utilizes four triodes (actually two twin-triode 6AQ8/ECC85's), which makes it as elaborate as one can find, except for tuners which cost nearly as much as this whole receiver. The first r.f. stage is a grounded-grid amplifier and the other sections are the usual oscillator and mixer.

Following the front end are two 6BA6 i.f. amplifiers and two 6AU6 limiters. The tuning meter is driven by a signal from the first limiter.

FM detection is accomplished by a discriminator circuit utilizing a 6AL5. From this point, the signal goes either directly to the audio amplifier, with proper de-emphasis, or to the multiplex decoder, depending upon the selector switch setting. The decoder is of the matrixing type (rather than the time-division type) and is not unusual in this category. It is not skimpy however, and utilizes four triodes, a pentode, and four crystal diodes.

The AM section is somewhat less elaborate than the FM section. It consists of a 6BA6 r.f. amplifier, which receives the signal from the ferrite-bar antenna; a 6BE6 converter; a 6BA6 i.f., which is also the first FM i.f. stage; and a crystal diode detector. Serviceable but not elaborate.

The audio amplifier contains a low-level phono preamp to amplify the inputs from either magnetic or crystal cartridges, and provide RIAA equalization. The crystal input is arranged to handle the output of a high-quality crystal cartridge and convert the signal to one appropriate for the magnetic input path. Both sections of a 12AX7 are used in this phono preamp-equalizer section.

All high-level inputs and signals from the tuners go through the volume control to one section of a 12AX7 which functions as a tone driver. Both sections of another 12AX7 are next used as a driver and phase splitter. The output stage consists of a pair of 6BQ5/EL84's in push-pull connection. The output tubes are operated with a plate supply of 350 volts, which is the reason that this output stage is rated at 20 watts. In many cases, the 6BQ5 is operated with a lower plate voltage, with resultant lower power output. The output impedance of the transformer is switchable by means of a slide switch so that there is only one set of lugs for each speaker, rather than the four commonly found. One can select either 8 or 16 ohms, although there is a 4-ohm tap on the output transformer. This tap is used only for matching headphones. A feedback loop is used around the output stage, feeding back voltage from the 16-ohm tap of the output transformer and returning it to the cathode of the output driver.

The power supply uses a pair of silicon diodes in a rectifier circuit for plate supplies, and various windings on the power transformer for the filament supplies. A single unfused, but switched, convenience outlet is provided.

It should be noted that the general construction and quality of components (resistors, capacitors, and such) is quite high.

Fig. 1. Kenwood KW-40 AM-FM-FM-stereo receiver

Performance

AM sensitivity of the KW-40 is 250 microvolts IHFM and the frequency response is within ±2 db up to 6000 cps. Above this frequency the response rolled off rather steeply, a not too uncommon situation with AM tuners.

FM sensitivity is 8 microvolts IHFM and the capture ratio 4.5 db. The frequency response in mono is within ±1 db from 20–20,000 cps while in stereo it is within ±1.5 db from 50–15,000 cps. Stereo separation is over 33 db at 1000 cps.

The power output of each amplifier sec-

We'll stack the KW-40 against the best-known names in the industry.

Even though it costs at least $50 less.

The Kenwood KW-40 combines AM–FM/Stereo tuning, preamplification and amplification on a single chassis and gives you the fine performance you expect from the best separate-component systems. The only way to get greater command over music is to become a conductor.

The KW-40 is a fully-integrated AM–FM/Stereo receiver combined with dual-channel 20-watt amplifiers. Its credentials include amazing sensitivity (1.9 mv for 20 db quieting) and stereo separation of more than 38 db. An on-off Automatic Frequency Control heads like a homing pigeon for the clearest sound in the channel. It has an exclusive sub-channel circuit that bypasses monophonic FM transmission to provide positive identification of stereo stations. An AM circuit and built-in antenna will satisfy any sudden desire you might have for standard broadcasts.

The KW-40 takes tape. It takes records. Feeling selfish? A headset jack enables you to enjoy your stereo all by yourself. And as much as you will appreciate the sounds you get, the sounds you don't hear are important too. The KW-40 DC filament circuit hushes hum. Its high-frequency filter scrubs out scratch. Its low-frequency filter rubs out rumble.

But the biggest surprise is written on the KW-40 price tag. $224.95. At least $50 less than anything else as good.

Kenwood

Kenwood Electronics, Inc. • 212 Fifth Avenue, New York 10, N. Y. • 3700 South Broadway Place, Los Angeles 7, Calif.

tion is 22 watts at 1000 cps with less than 1 per cent harmonic distortion, with one section being driven at a time. With both sections driven, the output is 19.5 watts at 1000 cps and 1 per cent distortion. IM distortion at 20 watts is less than 1 per cent. At normal listening levels (1 watt output) the frequency response is within 0.5 db from 20–20,000 cps.

For those who are not interested in engineering specifications, the KW-40 is a good-sounding AM-FM-Stereo receiver which sells for a modest price. It is definitely worth considering if you are interested in an all-in-one unit. D-22

HARMAN-KARDON CITATION "A" KIT

At the time we reported on the Citation A in the October, 1962, issue, the kit was not yet available, but even though it is our policy to report on kits *only* when we have personally built one and tested it, we made an exception because the existence of a high-grade transistorized preamplifier-control unit was of immediate news value. At that time we had the unit in our possession less than 48 hours, and we do not feel it is possible to test anything adequately without living with it for a time. All we could do was to measure it thoroughly and to listen selectively but briefly.

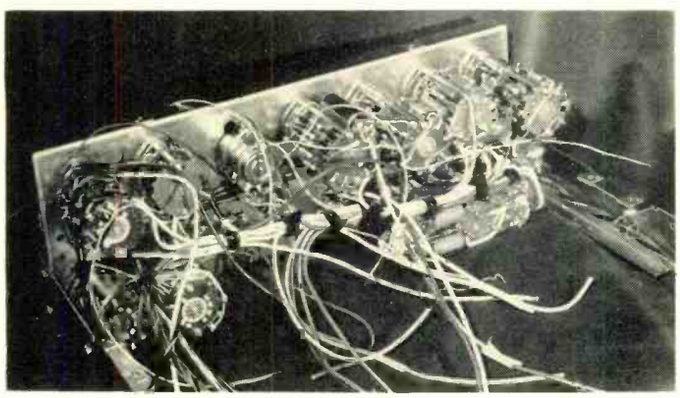


Fig. 2. Rear view of the front section of the "A" after 24 hours of construction time. Total time required was 29 hours.

The kit finally arrived late in January, and we promptly dropped everything else and started work on it. First, let us say that the instruction book and associated drawings are exceptionally lucid *and accurate*. After completing the construction, we made one or two minor suggestions which were not corrections but actually only suggestions reiterating some of the cautions appearing in the introductory material. We found only one error in the drawings—and even then, the written instruction was correct for the operation.

The construction project is massive, to say the least. The front panel of the completed unit can be seen on page 37, but *Fig.* 2 shows a rear view of the front panel at the completion of 24 hours of work—the total time required was 29 hours. There are just under 800 separate instruction steps, and many of these consist of several individual operations. For example, item 34 on page 28 says: "Slip a ½" piece of black sleeving over one end of a 13½" green shielded wire. Strip ½" of outer insulation and cut off shield. Strip ¼" of inner conductor and connect to SJC-2 (NS). Push sleeving up to lug. Strip 1" of outer insulation from the other end, twist and tin shield. Strip ¼" of inner conductor, tin and leave free." Thus it can be seen that the 800 operations are really more like 2000.

The assembly involves the preparation of the power supply section first; then one proceeds to the wiring of the four tone-control switches, two equalization switches, and the mode and selector switches. Each of these becomes a complete sub-assembly to be mounted on the front panel later—from *Fig.* 3 at 24 hours to a completed amplifier at 29 indicates that the final assembly goes very fast.

Since the major part of the wiring consists of assembling the switches, most of which have a large number of resistors and capacitors on them, along with strapping of the various contacts, we "invented" the device shown in *Fig.* 3 to make it much simpler to reach each part of the switches. The device consists of an ordinary ball-and-socket tripod fitting, which is clamped into a bench vise. A short U-shaped bracket was made with a ⅜-in. hole in one side and a ¼-in. hole in the other. The tripod screw goes through the smaller hole, with a ¼-in. nut holding the bracket. The switch is mounted through the larger hole, and held in place with a nut. With this device the switch can be held in practically any position to facilitate mounting of parts. Unfortunately, we did not invent this device until we reached the last switch.

Performance

At the outset, we wondered if the "home" built unit would perform as well as the factory-built unit reported on previously—we had the idea that in the earlier stages of production the amplifiers might possibly be checked especially carefully to make sure that the line was functioning properly. So we made another complete set of measurements—with practically identical results. Distortion measured exactly the same as the residual distortion in the generator (.06 per cent) up to 4 volts output, increasing to about 0.18 at 6 volts, the maximum output. Hum and noise measured 72 db below 1 volt on phono with the volume control set for a 1-volt output and 10 mv input. On the high level inputs, noise was 86 db below 1 volt with the volume control set for a 0.5-volt input, and with the volume control off, the noise measured 100 db below 1 volt. Gain of the two channels was within 2 db, all curves were within ±2 db throughout, and response on "flat" was within ±0.25 db from 10 cps to 100,000 cps, using the same instrument for measuring input and output. For complete performance data, the reader is referred to the earlier PROFILE.

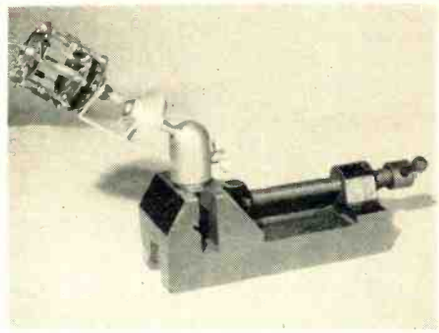


Fig. 3. Helpful jig devised to simplify the wiring of the many switches.

After a month of "living with" the unit, with a use of at least six hours a day, the measurements were repeated—with exactly the same results. It would appear that transistors *can be* all they claim for them.

As a construction project, the "A" is interesting and, considering the instructions, educational. The delicate work of assembling the modules on which most of the transistors are mounted is already done at the factory, and the individual modules are thoroughly tested. All that remains is to connect up the various parts—with all of its 800 operations, almost 600 soldered joints (exclusive of tinning the leads and shields before connecting), and at least 29 hours. But the result should make any audiofan happy. D-23

ACOUSTIC RESEARCH TWO-SPEED TURNTABLE

As a reviewer we are in a rather fortunate position when it comes to reviewing this piece of equipment. First of all the company is well known. But even more important, the designer of the instrument has already presented an extensive description of the product in an article we published previously (September and October, 1962, issues). So we don't have to use space to discuss the design. All that remains is report on its performance.

Before doing that we would like to call your attention to the fact that this table differs slightly from the one Mr. Villchur described in that article—it's a two-speed unit (45 and 33⅓ rpm) whereas he was talking about a single-speed (33⅓ rpm) table. As far as performance goes, the ad-

(*Continued on page 54*)

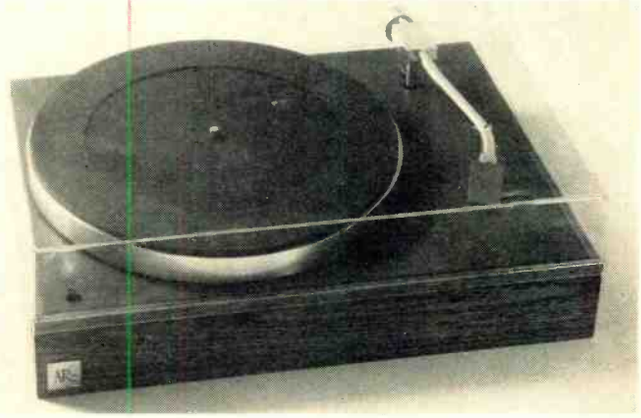
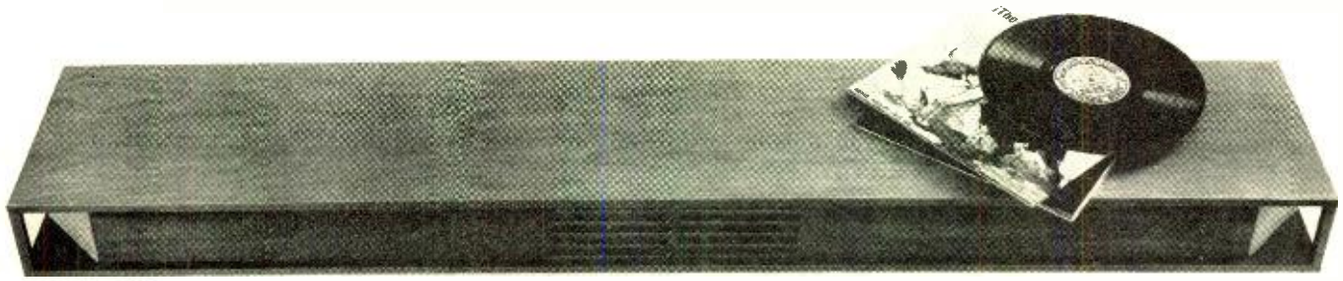


Fig. 4. AR two-speed turntable.

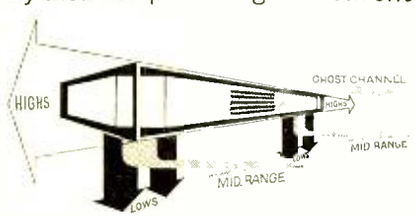
WHO SAYS YOU NEED 2 CABINETS FOR STEREO?



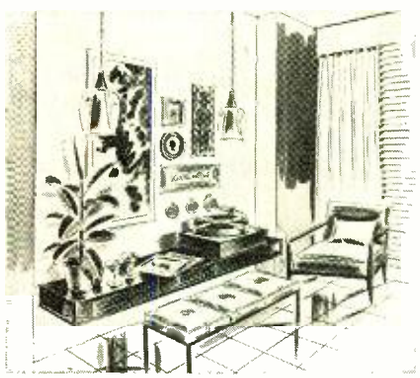
THIS IS SONORAMA BY REK-O-KUT...THE FIRST COMPLETE, OFF-THE-FLOOR STEREO SPEAKER SYSTEM IN ONE UNIT!

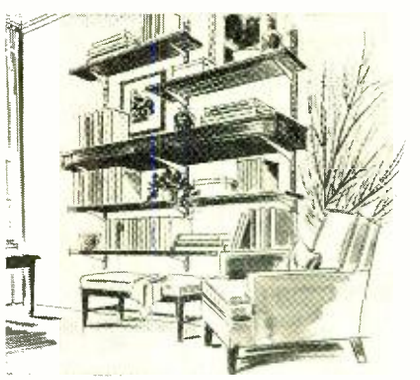
SONORAMA by Rek-O-Kut is now changing a lot of people's minds. This all-in-one stereo speaker system can be placed *anywhere* in a room and *fill* that room with beautiful stereo. No matter where you sit, you'll hear vivid, clear separation of sound. You'll distinctly hear its big bass, magnificent mid-range and superb highs. Play a symphony recording and everyone in the room will feel as if he were on the conductor's podium. What's more, there's no chance of a big "hole-in-the-middle" that's often caused by improper speaker placement.

How has this been done? Rek-O-Kut sound engineers set out...several years ago...to create the one multiple stereo speaker system that would solve the space situation in small apartments, playrooms and in hard-to-stereoize rooms. SONORAMA was the result. Inside this one unit are six high-efficiency speakers...as many as are normally found in two speaker systems. By their unique arrangement in one



enclosure that is just 5" thin, 12" deep and 67" wide, sound is dispersed as shown in the diagram. Mid-range frequencies are directed downward and outward through openings in the bottom of SONORAMA. High frequencies emanate from super-tweeters that are angularly placed at each corner. Bass frequencies take two directions, both downward through their own diaphragms, and through a third "ghost" channel inside SONORAMA and then out the center. Thus, SONORAMA sends out a full 180° "curtain of sound" that fills every corner of a room!





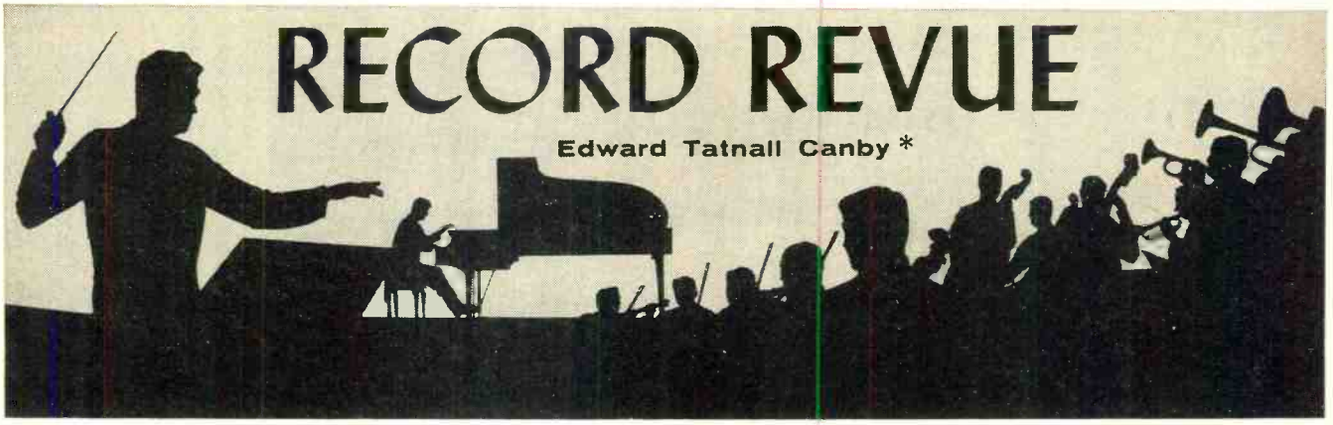
But there's another side of the SONORAMA story. Rek-O-Kut consulted top interior decorators to help us design SONORAMA for your home...to please the eye as much as the ear. Thus, each SONORAMA is also fine furniture. Three styles are available to fit and enhance any decor: Contemporary, in Danish walnut; Early American in solid maple; and French Provincial, in fruitwood. SONORAMA can be placed on any wall...high or low...and its use is limited only by your imagination. Shown left are just two possibilities.

And here's the most pleasing news of all. SONORAMA...beautiful to listen to and look at...brings you true stereo at a down-to-earth price. Just *$149.95** for the Contemporary Model, *$179.95** for the Early American or French Provincial. Your high fidelity dealer will be happy to demonstrate SONORAMA for you. For further information and the name of your nearest dealer, simply write: Rek-O-Kut, Dept. AU-4, 38-19 108th St., Corona 68, New York.

SPECIFICATIONS—*Speakers:* Two 8" woofers. Two 8" mid-rangers, and two super-tweeters. *Response:* 40-18,000 cps. *Sound Dispersion:* 180°. *Impedance:* 8 ohms. *Power Handling Capacity:* from as little as 2 watts up to 50 watts. *Dimensions:* 67" wide x 12" deep x 5" thin! *Weight:* 36 pounds.

*Complete with L-shaped brackets for easy wall mounting and ten feet of flat, white, 4-color-coded cable for immediate hook-up.

REK-O-KUT



RECORD REVUE

Edward Tatnall Canby *

MUSIC GUILD

Johann Christian Bach: Dies Irae. Solos, Polyphonic Chorus of Turin, Angelicum Orch. of Milan, Maghini.

Music Guild S-29 stereo

James Grayson's Music Guild, recently founded, is a successor to Mr. Grayson's original Westminster label of 1950. (He has recently been reappointed at Westminster, which is now a subsidiary of ABC Paramount.) The Guild sells by mail (*information: 111 West 57th St., New York*) and through selected dealers of the type who will treat its offerings with respect. Many of the releases are imported from varied European catalogues; this one is from Angelicum in Italy.

The "Dies Irae" by Bach's youngest son, the "London" Bach, will surprise record collectors as much as did the first rediscovered sacred music by Vivaldi—both men wrote prolifically in church style but their output was long ignored. This excerpt from a Requiem Mass is out of Christian Bach's youth, a product of study in Milan with the famed Padre Martini, and it clearly displays its semi-Italian origin, foreshadowing similar later work by Mozart—the great "Requiem" —and echoing the "Stabat Mater" of Pergolesi, to name two relatively familiar works. For most of us, this might be called a pre-Mozart sound. The typical "business" of the accompanying orchestra, the flowery but not too well-defined melodic ideas, are very much of the period; Mozart, who was soon to come to Italy himself as a child prodigy, was just a year old when this music was first performed.

A rich and wobbly performance, this, very much in current-day Italian style, out of Puccini and Caruso! Unlike some Italian recordings, this one features no lapses in pitch. Quite acceptable if you don't mind vibrato.

Great Organs: Silbermanns at Marmoutier, Ebermunster. (Bach: O Gott Du Frommer Gott; Partita in C Minor. Boyvin: Organ Works, First, Second Book.) Noelie Pierront.

Music Guild S-26 stereo

The Silbermann organs were the acme of organ building in the great age of the Baroque instrument. Celebrated in their own day, they remain today as superb examples of organ sound. The Silbermann clan was from Strasbourg and hence their organs, in spite of Germanic names, have a French history mixed in with the German.

Here a French organist of today plays two great Silbermanns in present-day Alsace. On one we hear Bach; on the other a relatively unknown late Seventeenth century French organist, Boyvin, whose music is impeccably styled in the French manner and a pleasure to hear. What lively organ sounds from these Silbermanns!

Monteverdi: Secular Vocal Works. Hugues Cuenod, tenor; Jidith Davidoff gamba, Robert Brink, vl., Daniel Pinkham, hps.

Music Guild S-27 stereo

A solo recital, this Monteverdi concert by the veteran Cuenod, who sang in the famous pre-war Boulanger Monteverdi recordings, is surely an aesthetic triumph though the style of the performance is, by now, a bit old-fashioned. Cuenod's voice has always had a somewhat tense, hard character, sometimes to the point of out-of-tune singing. But here, as an elder statesman of old music, he is relaxed, his tones full and rounded and wholly musical. A pleasure to hear.

The long work, "Lettera amoroso" (Love Letter) was the sensational feature of an acclaimed New York performance. Other late-Monteverdi works are added here, to round out the two sides.

Riverside Chamber Singers (Deering, Victoria, Weelkes, Schutz, Monteverdi, Le Jeune, et al., "Trois Chansons" by Debussy.)

Music Guild S-20 stereo

This professional group of American young people combines a youthful earnestness and enthusiasm with the characteristic vocal tone of the American-trained singer—thick, brilliant, rich in vibrato. The enthusiasm is immensely welcome, as is the excellent musicianship and discipline of ensemble. The "clotted cream" tonal blend, however, is highly unsuitable for most of the early music here performed. Not a thing can be done about it; one cannot "unlearn" the physical result of years of physical training.

All the music is of the "Golden Age," ranging through French, Italian, Netherlands, English masters of the late 16th century on into the early Baroque of Monteverdi and Schütz—with one odd juxtaposition: the three short works be Debussy. The singers have something still to learn about the rhythmic flexibility and freedom of accent in the early music but one senses that they are on the way to discovering it for themselves, simply by dint of much singing.

MULTI-MIKED "NINTH"

Beethoven: Symphony No. 9. Solos, London Bach Choir, London Symphony, Monteux

Westminster WST 234 (2) stereo

Sensational! Controversial! Here is the up-to-date example par excellence of the American-style stereo pickup, using many mikes widely separated. In the past I've taken exception to Kurt List's Westminster stereo productions; this time he has produced a masterpiece of its type —and the performance is a masterpiece as well. Rarely have I heard such a musical impact, such an exciting presence-sense, such an effective balance between solos, chorus and orchestra.

The multi-mike technique, distrusted by our continental engineer friends, tends to create a "new sound" such as has never existed in music before. In principle, I find this good, not bad. (Reproduced music is always a thing apart from "live" music, the connection between the two more tenuous than specific.) At its worst, this technique produces "ping pong" left-right separation: or it leads to a kind of musical suspension in mathematical space, all sounds seemingly at the same close range. At its best, as here, there is no "ping-pong" at all; and the synthetical equality of spatial effect means that—for once—the huge chorus is as convincingly real as the large orchestra; the two are "superimposed," one on the other, at the same apparent distance, That is what the Ninth Symphony on records has been looking for all these thirty-odd years since it was first recorded.

The performance is superb—again, of its sort: a British orchestra and chorus under the greatest of French conductors. Straightforward French clarity and accuracy, earnest, high-level British performance, plus the drive and excitement that are unique with old "Papa" Monteux. For once, Beethoven's great opus hangs together right to the last note.

No good for FM broadcast? The M-X stereo proponents are probably right in suggesting that this type of recording produces serious phase-cancellation distortions when the record is played mono or is transmitted via multiplex. Does that mean we can't enjoy it as it is meant to be enjoyed—in straight home stereo?

A revealing rehearsal montage occupies the fourth record face. Monteux close-up, complete with Americanized French accent. ("Come on, now!")

MORE BIG MUSIC

Bach: Concerto in A Minor (harps, flute, violin); Concerto in D Minor (violin and oboe); Brandenburg Concerto No. 3. I Musici.

Philips PHS 900-008 stereo

I Musici of Italy, heard on various labels before, turns up here on Philips (via the local Philips acquisition, Mercury) in an excellent Bach record, featuring two unusual concerti out of Bach's numerous re-arranged works. The D Minor is reconstructed for a violin-oboe combine out of the later re-arrangement as one of the harpsichord concerti, and a lovely work it makes in this probably authentic form —the original is lost. The A minor is a big triple concerto for the same pattern of instruments as the Fifth Brandenburg, a work on the largest Bach scale. Good, somewhat tense Italian playing, beautifully disciplined.

Heifetz. Bruch: Concerto in G Minor. Mozart: Concerto in D Major. Jascha Heifetz; New Symph. Orch. of London, Sargent.

RCA Victor LSC 2652 stereo

RCA's fare is comfortably predictable, as always. The old stand-bys of the repertory, the old standbys of the RCA artist roster, even if in new surroundings, imported.

Well, certainly Heifetz is not "failing" yet! Not here, anyhow. His playing scintillates with youthful accuracy and we can assume he didn't have to play too many re-takes to provide the same. RCA's recording via London is of the old-fashioned sort, too, blowing up the solo violin into a huge and golden thing a mile high. What else—for Heifetz.

As for the Bruch, it is as always, a big, earnest, skillfully written piece of Romantic violin show-stuff, out of the serious German school, and it plays into Heifetz' hands to perfection. No doubt this is his 1000th performance of it. I find it pretty dull, in spite of these noble efforts. And the Mozart came close to irritating me—for here is the old, outworn way of doing Mozart, self-consciously, charmingly, with a much-too-big sound all around and a patronizing attitude (neatly reflected in the program notes on the record jacket) which is quite unnecessary today—when Mozart is far more familiar to most listeners than Bruch himself.

Beethoven: Triple Concerto (Piano, Violin, Cello), Op. 56. Anda, Schneiderhan, Fournier; Radio Symphony (Berlin), Fricsay.
Deutsche Gramm. LPEM 19 236 mono.

(Note: This and other D-G discs once handled by Decca are now available through M-G-M.)

This big, obstinate middle-period Beethoven work is seldom heard in concert—too many cooks spoiling the broth for a public performance. But on records it has a much better chance to shine and this disc will give you a grand opportunity to assess its plus and minus attributes as rugged Beethoven of the biggest kind. Also in stereo.

Brahms: Piano Concerto No. 2. Leon Fleisher; Cleveland Orch., Szell.
Epic BC 1253 stereo

This is the inevitable successor to the outstanding recording of the First Concerto by the team of Fleisher and Szell—it upholds the same standards and rates as one of the very best performances of the work in modern recording. Fleisher's dignified grasp of the essence of Brahms is amazing, both for one of his youth and for an American pianist—most of them do Brahms merely flashily. Indeed, one feels that the Fleisher dignity and understanding at the piano keep the somewhat more temperamental Szell in hand and at his best. The younger man has plenty to teach the maestro—any maestro.

Dvorak-Smetana. Slavonic Dances. The Moldau. Austrian Symphony Orch., Hagen. **Everest 6104 mono**
Brahms: Symphony No. 1, Bamberg Symphony, Hollreiser.
Everest 3101 stereo

What's in a name? Everest was presumed dead some time ago, and a big loss it was to those who collect fine sound and good performances. Now—suddenly Everest is alive again, with a new West Coast address. What gives?

Well, I wonder. The new material, I would have guessed, is the sort one can acquire these days in Europe without undue trouble—normally it is ready-recorded, or taken down by some European concern and imported by our local outfit. Everest once was, as these labels proclaim, "First in 35 MM." True, true. Are these recordings made on 35MM? It doesn't specifically say so, though the above motto is prominently displayed. I'd like to be persuaded. My ears wonder.

The Brahms First is a good modern stereo recording of an accurate, somewhat chaste performance that avoids any show of excess sentiment. Interesting and the accuracy is welcome. Sound is OK, not unusual.

The "Dvorak Smetana" record is typical of several. Maybe my ears are plugged up, but I fail to hear any highs at all, nor much bass, in the Smetana "Moldau" music. Just one long, muffled, shapeless sound, at a distance. The Dvorak dances, evidently recorded on a different occasion and maybe with different personnel too, are slightly brighter. Not much. Pretty sad sound. Especially if, by any chance, it comes from 35MM tape.

Bach Organ Music, Vol. 2, Carl Weinrich.
RCA Victor LSC 2649 stereo

Volume Two in this series contains the familiar C Minor Passacaglia, the Toccata, Adagio and Fugue in C, Toccata and Fugue in F, Prelude and Fugue in G—a brace of brilliant show pieces. Carl Weinrich and E. Power Biggs together were the pioneers in popularizing "Baroque" organ music in America. Biggs started on RCA Victor and carried on his Sunday broadcasts for many years; Weinrich began before LP with an unprecedented 78 rpm series for the old Musicraft label. When Biggs went over to Columbia Records, Weinrich was with Westminster; now he has taken over at RCA as "staff" Baroque organist, in the old Biggs spot.

Pioneer or no, I find Weinrich here very much the same as Weinrich on Westminster—an expert technician but somehow a cold, steely performer, tending to a driving, metronomic beat and (like Biggs) too often falling back on the meaningless staccato touch that most organists learned in their salad days of playing on old-fashioned muddy church instruments. And somehow, too, RCA manages to make this fine organ (in a fine chapel) sound remarkably like the old Biggs RCA organ, an oddly featureless drone lacking in acoustic presence.

Beethoven: "Emperor" Concerto. Rudolph Serkin; New York Philharmonic, Bernstein. **Columbia MS 6366 stereo**
(mono: ML 5766)

One must have a catalogue mind to review records these days and I don't. I just like music. Thus I can merely suggest that I seem to have heard all this before; that more and more of the records I receive seem to be semi-repeats, with minor shiftings-around of personnel and microphones. I dunno—did Serkin record this concerto with the Philadelphia before? I won't bother to look it up—*you* can do that. Anyhow, here's Serkin at his usual bouncy best, high-tensioned, scrappy, enthusiastic, never allowing any music of which he is a part to become in the least way routine. Serkin isn't even polished. He's too scrappy for it. If there aren't any mistakes, then it sounds as if there ought to be—nice ones, out of sheer enthusiasm. And the faithful Lennie, Leonard Bernstein, plunges along with his orchestra in a similar sort of happy frenzy.

To my unpracticed ear, returning to hi fi after several months of vacation far from music, the recording sounds rather hard and too well varnished. Not mellow.

Handel: Concerti Grossi, Opus 6, Nos. 10, 11, 12. Handel Festival Orch. Halle, Hosrt-Tanu Margraf. **Epic BC 1243 stereo**
(mono: LC 3843)

Epic Records was founded (in a singular, quite oppositely from the British government, which are always plural) mainly as a vehicle for imports from Philips in Europe, as most record buyers have long known. It has had a curious relationship to Columbia Records, since the two are not even on the same corporate level in the CBS family, if I am right; yet they share processing, divvy up and often share artists, as well. Epic has been assigned such U.S. plums as the Cleveland Orchestra and George Szell.

Now, Philips has broken loose on its own. So where does that leave Epic?

Anyhow, this disc would seem to rate as unfinished business, since it is the third of a series containing the full dozen Handel concerti. Three are probably many more such items, to keep Epic.

Comments I've made before continue to apply. The Handel is played with accuracy, clarity, and great vigor—no mushiness, no over-heavy thickness. The instrumentation is reasonable and proper for the style, the sound is good. My one complaint, though, is fundamental. Herr Margraf is one of those many conductors who believe that, though one phrases and shapes a Beethoven melody, a Brahms theme, one plays "Baroque" music with machine-like precision, *martellato* (like a hammer), completely minus any phrasing. Crazy, I say—but the best conductors do it.

Clarity and precision are all very well, but a musical line must have a shape, like a sentence of words, and no less so in this earlier period than in Beethoven and Mozart and what-have-you. Not until melodic lines begin to break up into far-flung fragments in the very modern period can we put aside such a fundamental principle. Perhaps not even then. Ask Stravinsky. AE

AUDIO ETC

(from page 14)

record on the left and playback on the right could be better observed. Take the four input pots, for instance. Two are on your left, next to the record switch. Two more are on your right, surrounded by playback controls. Probably a matter of necessity; but the fact remains that this invites grabbing the wrong thing in an emergency. (Trouble is, they also can function along with playback, in this complex mixing system. Versatile, but confoosin'.)

I'd hate like poison to have to figure this problem out myself but, I'll bet, with a couple of years' hard sweating Crown's designers could do something about it.

3. Editing is difficult (if you edit—I do) because the solenoid-operated tape pressure mechanism is big, the small felt pressure pads do not move more than a ¼-inch or so away from the heads (and, indeed, are sometimes snagged by the tape during threading and de-threading). It is not easy to get a marking pencil in and the tape is hard to see. Moreover, the manual cue lever is clumsy and—I quickly discovered—tends to slow the tape to a stop when playing pressure is applied during forward or rewind speeds. You need three hands. A more serious editing difficulty: too many sharp edges and snagging projections.

In comparison, the Ampex non-automatic gate, minus pressure pads, is simplicity itself, for all editing functions. Couldn't Crown get rid of those nasty little pressure pads? Put a better manual leverage on the cueing device? Make tape path more snag-free?

4. Like many other machines, the Crown's fast motion gets going *very* fast, yet with big reels, at the extremes, near the reel end, there's barely enough power to start up again, once stopped. This is an almost inescapable problem, insoluble short of elaborate variable voltages. (Crown does vary the voltage, using full voltage only for start-up and the start of braking, but this doesn't seem to help with the larger reels.) All is OK with small reels. Only with the big professional reels does the problem become serious. Fortunately, Crown's STOP is sure and safe—when speeds begin mounting to a screaming maximum!

One can, I find, push stop en route, now and then, to slow the excessive speed. Good.

5. While I'm at it, I note that the Crown 800 is prone to a common tape-motion malfunction, the tight winding-up of tape folded around the hub behind the reel. It happens in the best machines including Ampex; but the Crown 800 has a biggish opening around the hub base, all set to gobble up tape. A smaller slot around the hub would help a lot, as well as a more controllable fast tape motion. A momentary slack followed by a quick pickup in tension is all you need to create this deadly sort of snarl in any machine. It's the worst of all, for tape damage.

6. I'm all for the large-reel fasteners Crown supplies: you can leave them

attached and with a quick twist the big reel is tightened in place or slips over and off. An expanding-spring in the hub's rim. But the seven-inch (and smaller) reel fasteners screw on and off and are just the right size to cover the slot where you're trying to loop the tape-end in place.

I still like the Ampex-type fasteners, same for all reel sizes. You just sock them on hard and they tighten themselves without a twist.

7. With all its multiple controls and input-output flexibility, the Crown 800 provides only one output (per channel) and no separate phone monitor arrangement on the front panel.

On the mono Ampex 350 there are three outputs, a "main," a rear monitor phone socket, *and* a phone socket on the front panel. Even the little model 600 provided a phone output separate from the "main" output.

Stereo, of course, raises new problems. Two channels. What sort of phones and connections should be provided? Two separate phone jacks? Or a single three-way "stereo jack? (Might cause ground complications.) And at what impedance? Normal "pro" monitor circuits require high-impedance phones, but most common "stereo" headpones now are low impedance. Low impedance is what you'll find in many a hi-fi home, like it or no. Crown has a problem here, as do we all.

Nevertheless, the need for monitor phones is just as great in stereo as it ever was in mono days—phones, mind you, *in addition to regular outputs*, for true monitor use. On the Crown, one cannot monitor and feed a signal out at the same time. I found this distinctly inconvenient. I *always* want to hear what's going on.

My best suggestion—to all tape recorder makers—is to consider for the future, maybe as an accessory when necessary, a stereo phone monitor facility for *low*-impedance stereo phones (a low-power amplifier, perhaps transistorized?) with a built-in "Bauer circuit" cross-blend, to provide accurate stereo perception in the phones, switchable so that each ear can monitor one channel alone, or either channel may be fed to both ears mono. Tricky and not cheap, but this would be an extremely useful addition to any stereo recorder, especially to one as versatile in other respects and as complete as the Crown 800.

A final word and a postponement of an interesting question: what mikes should the non-pro recordist acquire to go with his Crown 800, which of course is sold mikeless? At such a price and with such high quality, you are obviously expected to own or acquire equally good associated equipment to complement the Crown. Otherwise why buy it? Good amplifiers, speakers, turntable, cartridge, radio tuner. Most of all, good mikes. Two of them, for your two channels. *What* microphones?

Well, I'll only remark, for your present edification, that after considerable inquiry and discussion, here and there, I ended up with the loan of a pair of Schoeps condenser mikes. Total cost—to you—about as much as the recorder itself! I hate to say so, but the logic was inescapable. More on this expensive subject later. Better start saving. AE

EQUIPMENT PROFILE

(*from page 48*)

dition of the second speed makes no difference; the AR turntable performs exceedingly well at either speed. On the other hand, considering the procedure one has to go through to change speeds, it would seem a useful feature only for those people who use their tables at either of these speeds for long periods of time. In order to change speeds one has to lift off the record mat, remove the outer portion of the platter, lift the belt from one pulley surface to the other, and then replace everything. It is easy, but rather lengthy for only one record or so.

Perhaps the recent introduction of several high-quality 45's induced the AR people to make this speed available. Or maybe it will induce more record manufacturers to make high-quality 45's. We hope so.

Another point that wasn't really covered in that article is the complete group of accessories that accompany the AR turntable, at the one remakably low price ($58 for the one-speed, $68 for the two-speed version). Aside from the turntable and arm, which are already a good buy at that price, there is a walnut base, a hard-plastic dust cover, an overhang adjustment gauge, a stylus-force gauge (we described it in the January, 1963, issue), a small screwdriver for mounting the counterweight and the cartridge, a bottle of oil for lubricating the appropriate parts, and an exceptionally complete and clear instruction book. Unquestionably, the AR people have spent much thought and intelligence to make this unit as foolproof as possible. It is.

Performance

There is one thing that a turntable must do, and one thing that it must not do; It must operate at exact speed and it must not introduce "signal" of its own. The AR turntable does run at exact speed (both speeds), and it introduces as little "signal" of its own as any turntable we have had occasion to test. In the latter category we itemize wow and flutter of less than 0.04 per cent (and some of that is due to the measuring instrument), and rumble down 40 db. Add to this the fact that the rumble frequency is below 10 cps (due to the lower rpm of the motors used).

An additional factor in preventing the introduction of unwanted noise is the mounting system; the arm and platter are mounted on a rigid beam which is isolated (hung) from the motorboard by means of compliant mounts. Thus vertical shocks appear, to the arm, the same as a warped record. Lateral shocks (those which move the motorboard toward the side) are absorbed partially by the compliance of the mounts.

The arm accepts cartridges which can track well at 1 gram. Basically, the arm has sufficiently low friction to handle even a lower tracking force. The problem is to get a cartridge which will operate well at lower tracking forces.

Altogether, the AR turntable, one speed or two, is an excellent buy, and it would be an excellent buy at a higher price. **D-24**

PHILHARMONIC HALL

(from *page 40*)

proven way to solve this problem.

On the output side, the speaker system, the solution has been used before, but possibly never so carefully designed. Since the Hall is primarily designed for orchestral music performance and is quite reverberant, the reinforcement system is designed to minimize reverberation by concentrating the sound energy on the audience and carefully preventing any sound from reflecting off the wall and ceiling. This was accomplished by placing all the speakers in one cluster just above and forward of the stage. Theater-type directional horns were used in order to "place" the sound exactly where it was required, and no place else. Naturally, there is a certain amount of errant sound which wanders off the selected path but, as mentioned before, nobody seems to have noticed it.

The amplification equipment is of professional quality, designed to provide maximum life with a minimum of maintenance. Although the system is not stereo, the control console contains two channels: One for the reinforcement system in the Hall and the other to feed loudspeakers in other locations, recording equipment, or a broadcast station.

The Equipment Used

The equipment used at Philharmonic Hall was specified by the Acoustical Consultant, Bolt Beranek and Newman,

and installed by Sound Systems, Inc. The architectural firm with over-all responsibility was Harrison and Abramovitz. Most directly involved at BB & N was Dave Klepper, and at Sound Systems, Inc. it was Irv Woods. I mention these names because they were extremely kind and helpful in providing information. Especially, I must thank Irv Woods for spending time with me at the Hall itself so that I could get first-hand information.

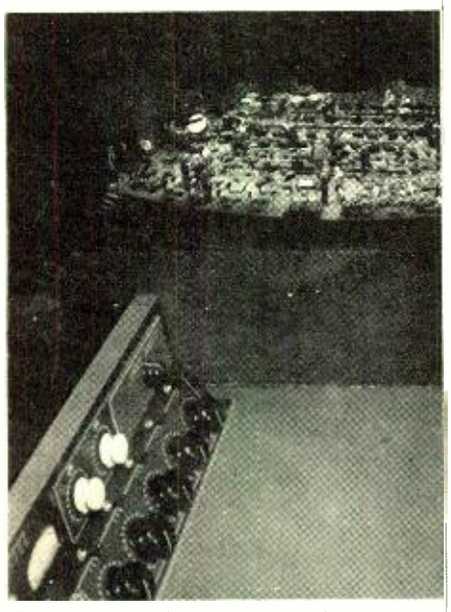


Fig. 4. View from the sound-operator's position in the sound room.

The equipment consists of the following:

Microphones—Dynamic and Ribbon

(2) Electro-Voice 666—unidirectional
(4) Altec Lansing 639B—polydirectional
(1) Electro-Voice 642—ultradirectional
(2) Electro-Voice 649A—personal
(2) Electro-Voice 655C—omnidirectional
(1) Altec Lansing 632—close talking

Microphones—Condenser

(4) Altec Lansing M-20—omnidirectional
(2) Altec Lansing M-30—unidirectional

Main Console

(1) Altec Lansing 250 SU (modified)

Remote Console

(1) Altec Lansing 1567A (modified)

Power Amplifier

(2) Altec Lansing 260A 260-watt amplifiers

Loudspeakers

(2) Altec Lansing 210 horns with (2) each 515 speakers
(1) Altec Lansing 1003 horn with 30210 throat and 288C driver
(2) Altec Lansing 1504 horn with (2) each 30210 throats and (2) each 288C drivers
(1) Altec Lansing 804 horn with 30172 throat and (2) 288C drivers

The following equipment has been specified but has not yet been installed:

(2) Transcription disc players containing a Gates or Collins turntable, a Rek-O-Kut or Gray arm, GE stereo and mono cartridge, GE or RCA preamp, and a GE equalizer
(2) Ampex 351-2
(1) Sherwood or Altec Lansing AM-FM tuner

Æ

JAZZ and all that

CHARLES A. ROBERTSON

Paul Desmond & Gerry Mulligan: Two Of A Mind

RCA Victor Stereo LSP2624

If a couple of intellects ever hit upon a fresh viewpoint while seated in front of a television camera discussing burning issues of the day, the conversation might possibly develop into something as enlightening as this joint commentary by Paul Desmond and Gerry Mulligan on a group of six songs. The themes are less momentous than those usually selected for televized forums, but both soloists bring original ideas and new insight to subjects which have been covered exhaustively before. One standard prop in studios of all types is a table bearing liquid refreshment, and home viewers often speculate on the alcoholic content of certain teapots shown on camera with distinguished guests. The recording fraternity has no need to practice such deception and rarely bothers to hide plainly marked bottles or soggy coffee containers. Jazz originals are another matter though, and the number of times a popular song has gone under a different name is an accurate test of its durability. In this case, a venerable Vincent Youmans hit supplies the basis for the album title and does a good housekeeping job by providing teacups to conceal the color of any beverages poured at the session.

The presence of Judy Holliday in the control room could hardly be the reason for observing the proprieties, as the fair visitor thought up the title for the only other original, *Blight of The Fumble Bee*. And if the cause of humor must be served still further in the course of one fast blues, listeners can stretch a point and insist they hear Desmond register a mild complaint at the pace by inserting a quote from *Don't Ever Leave Me*. The phrase serves equally well as an expression of sentiment about the entire affair, which like all good things is far too brief. "Classic-to-be collaboration" is the way the liner billing reads, and the prediction is less far fetched than a first glance would indicate. Especially memorable is *Stardust*, in a version designed to defy both the ravages of time and the coming invasion by flights of space vehicles.

Pianoless quartets are no longer much of a novelty and draw only passing comment in comparison to all that was written when Mulligan and Chet Baker first tried working with just a bassist and drummer. Progress has been too gradual since then for any great bursts of journalistic attention, but the peak of attention attained here for combinations of this kind should not go unheralded. The two saxophonists are eminently suited to the joining of forces in superb tonal blends, or exploiting the sharp contrast inherent in Desmond's alto and Mulligan's baritone. Stereo is helpful in achieving either effect, and Desmond utilizes it still further to add an extra track on the final choruses of *The Way You Look Tonight*. Wendell Marshall, Joe Benjamin, John Beal, Mel Lewis and Connie Kay all take turns on the rhythmic side of the table.

Joan Baez: In Concert

Vanguard VTC1653 (4-track UST tape)

If any folk singer is hardy enough to survive being immortalized on the cover of Time, Joan Baez may qualify by virtue of the bare feet which braved late November chill on newsstands and still keep her close to earth. The story accompanying the cover tells how folk purists open fire on the victims of public acclaim, and the accolade of Time would ordinarily be the signal for a withering attack. Unshod feet are on a par with homemade musical instruments as an ethnic symbol, however, and much superior to shirts opened at the neck to show various expanses of chest. These features should be sufficiently endearing to offset the stigma of eminence as a public figure, even though they are frequently used to depress the accelerator of a Jaguar XK-E.

Miss Baez's third Vanguard album was placed in circulation about the same time as the Time cover, and stereo tape now takes up the pleasant chore of spreading the news throughout the four-track world. As a companion volume of concert material is promised in the near future, comment on the program's full scope must be reserved until then, but there is proof enough that praise and reaching the legal age of twenty-one have yet to end her education and growth. The firm foundation once again consists of Child ballads, and Time insists any serious student absolutely must know the titles referred to by the numbers 81, 209, and 243. Woody Guthrie never counted the versions of *Pretty Boy Floyd*, but quite a few were probably tried out before settling on the verses heard here. This contemporary Robin Hood tale fits under the singer's spreading country wing, which also unfolds to cover *Copper Kettle*, a moonshiner song from Bexar County, Texas, and *Gospel Ship*, gleaned from a 1935 Carter Family recording. Taking care of the international quota are *Danger Waters*, from the Gold Coast of Africa, and the Brazilian *Ate Amanha*, a lover's farewell which Miss Baez dedicates to Pete Seeger and launches with an exuberance The Kingston Trio would be hard pressed to follow.

Those purists who complain that Miss Baez sings everything sadly may find an opposite reason for not approving the last item. Record reviewers are easier to please, and write glowingly about each new release, with no sign of ever becoming tired of the plaintive quality in her voice. Often a lonely sound, it is probably the reason why so many see no advantage in choosing stereo over the monophonic version. But it is also possible that Miss Baez is fooling everyone, as she undoubtedly takes great pride and pleasure from her vocal prowess. Any barefoot lass in the Appalachians would treasure such a possession, and joy is there for those who listen carefully. Clear and strong enough to carry across a valley from one steep wooded hill to the next, her voice and guitar belong in the still, open air. Even stereo tape falls short of bringing two hills into the living room, but the lift given the imagination can be mountainous.

Georgia Brown: Sings Kurt Weill

London Stereo PS274

The London production of "Oliver!" established Georgia Brown overnight as a star on her native heath, and Broadway audiences joined the cheering section on seeing her play Nancy, the leading feminine role in the musical based on Dickens' plot. The original cast album spread her fame further afield, but the record-buying public is likely to assess her ability on the basis of this collection of Kurt Weill songs. Too many talented youngsters have made a mark with a good part or hit song, only to fall short when hurried into the task of surmounting varied material at a recording studio. Taking on the assignment during the London run, Miss Brown went to the studio after evening performances and began to record at midnight. Before she encountered Fagan and Bill Sikes, the underworld of MacHeath was experienced through parts in London and New York revivals of "The Threepenny Opera."

That she also studied the art of Lotte Lenya at length is evident in the early songs, as no one else sings them with greater feeling and understanding. A wholly contemporary approach saves her from being another pale copy of the original, while good taste keeps her from the surface mannerisms of a Bobby Darin. A background in jazz singing, which began in cabarets when she was seventeen, and a throbbing contralto voice are both assets when the scene shifts to Weill's works for the American theatre. Ian Fraser's arrangements are entirely in character, his conducting never interferes with the singer, and stereo sets footlights aglow all across the stage.

Orchestra Saxsambistas Brasileiros: Desafinado

Dauntles Stereo DS6304

Zaccarias: Dance The Bossa Nova

Camden Stereo CAS749

While jazz musicians in this country are well attuned to bossa nova, the large popular dance orchestras are just beginning to catch up. Judging from early attempts, some may never make the grade. These low-cost imports present native Brazilian bands in ballroom dance sets that are also highly listenable. Besides being thoroughly experienced, both groups maintain slow or medium tempos for the benefit of novices trying to navigate the new beat for the first time. The Saxambistas Brasileiros live up to their name, juggling ten saxophones over a broad stereo expanse under the expert guidance of a seven-man rhythm team. Brazilian composers are responsible for the dozen numbers, and several fresh candidates mingle with hits already established in these parts. Instructions supplied by the Albert Butler School of Dancing are printed on the liner, with charts illustrating such technical points as the Brazilian Turn, Rio Rock, Copacabana Promenade, and Bossa Nova Box.

Zaccarias heads a suave and sophisticated band which many hotels would be happy to hire right now. Among the outstanding features are the leader's silken clarinet solos, styled midway between the rhapsodizing of Latin flutists and the swing school of Benny Goodman and Artie Shaw. The program is divided between native tunes and clever arrangements of such standards as *Lover*, *Holiday For Strings*, and *Bye Bye Blues*.

Judy Collins: Golden Apples Of The Sun

Elektra EKL222

Folk purists may still place a premium on a performer's amateur standing and life-long residence in the backwoods, but the new crop of singers have discovered that every bit of professionalism counts. In a promising debut on a previous Elektra album, Judy Collins sounded very much like a pleasant young housewife who had learned folk songs to entertain the family circle and small gatherings of suburban neighbors. This lack of commercialism failed to draw much purist acclaim, so the stigma attached to a Denver birthplace must be blamed for the tepid reception. As it was too late to do anything about a geographical error of twenty-three years ago, Miss Collins began mastering every trick of the trade for her next recorded appearance. She now keeps varying degrees of intensity stored ready on the shelf in Mason jars, and snaps off the covers with the expert ease of a moonshiner tending still in the hills. And Joan Baez, just around the next bend, always has a half-cup or so of plaintiveness to spare.

This second effort also benefits from broader programing, ranging from the lovely adaptation of a W. B. Yeats poem selected for the title to Mike Settle's ebullient *Sing, Hallelujah*. Walter Raim, who also assists on guitar, provides romantic couples with an arrangement of an old Polish song, *Tell Me Who I'll Marry*, and even the children are remembered with *Little Brown Dog*. But those listeners in search of ingenuous charm might try sampling her first offering.

new from SHURE

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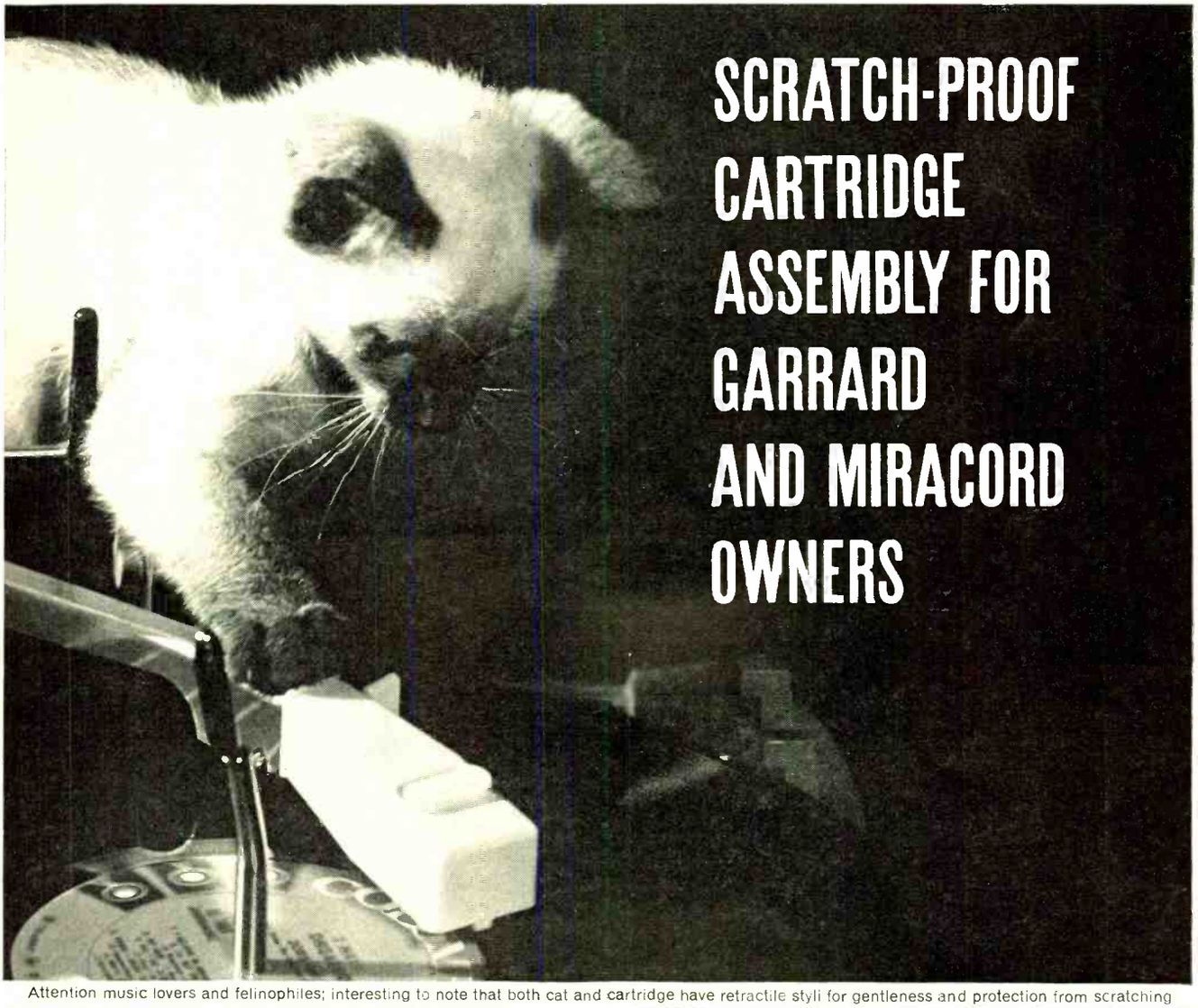

Attention music lovers and felinophiles; interesting to note that both cat and cartridge have retractile styli for gentleness and protection from scratching

GREATER RECORD AND NEEDLE PROTECTION . . .
FINER RECORD REPRODUCTION

Now, owners of Garrard Laboratory® Type "A" and AT-6 and Miracord Model 10 and Model 10H Automatic Turntables can assure themselves unprecedented and unparalleled record and needle protection, and highest sound quality simply by plugging in the Shure Stereo Dynetic GARD-A-MATIC "floating" cartridge assembly. Nothing else to buy . . . no wiring, no soldering, just plug in.

Ingenious GARD-A-MATIC cartridge inside a special tone-arm shell ends scratching due to dropping the tone arm or accidentally dragging it across the grooves . . . records stay new, sound new. Needles last longer—can't be damaged by pressing arm on record. Does away with tone arm "bounce" from floor vibrations, etc. Even plays warped records. And, the performance characteristics are those of the famed Shure Stereo Dynetic cartridges.

SPECIFICATIONS

Frequency Responses:	From 20 to 20,000 cps
Output Voltage:	6 millivolts per channel
Channel Separation:	more than 22.5 db at 1000 cps
Recommended Load Impedance:	47,000 ohms
Compliance:	20.0 x 10^{-6} cm per dyne
Tracking:	1.5 to 3.0 grams
Inductance:	600 millihenries
D. C. Resistance:	750 ohms
Stylus:	.0007" diamond
Stylus Replacement:	N99

MODEL M99/A. Fits Garrard Laboratory® model "A". Includes tone arm head, factory mounted cartridge, .0007" diamond. **MODEL M99/AT6.** Fits Garrard AT-6. Includes tone arm head, factory mounted cartridge, .0007" diamond. **Model M99/M10.** Fits Miracord Models 10 or 10H. Includes tone arm head, factory mounted cartridge, .0007" diamond. **MODEL N99.** Replacement stylus assembly, .0007" diamond.

SHURE Stereo Dynetic® GARD-A-MATIC T.M.

Patented and Patents Pending

CARTRIDGE ASSEMBLY

WRITE FOR DETAILS TO: SHURE BROTHERS, INC., 222 HARTREY AVE., EVANSTON, ILLINOIS

MONOPHONIC

Bunk Johnson & His Superior Jazz Band
Good Time Jazz M12048

Landmarks still crop up in jazz recording history, which is the best indication that the music and industry are very much alive in this jet-propelled age, but this reissue set remains in a class by itself. The first in a series of 1942 Bunk Johnson sessions, it introduced unknown New Orleans musicians and helped start a revival of traditional jazz. The three 78 rpm talking sides first documented the spoken testament of a jazz player, and copies of the fifty signed and numbered sets have sold at auction for as much as $150. The complete text of Johnson's famed account of his part in training young Louis Armstrong is reprinted on the liner, and Dave Stuart relates how he and several other collectors located the venerable trumpet player and got a band together for the date. It was also the first time any small jazz label ventured outside major recording centers, a move which nearly caused the project to be postponed.

While the task of recording in any corner of the world is much simpler these days, amateurs still do a good part of the adventuring. New Orleans studios were closed then as now to Negro performers, but the visitors learned about the restriction only after their arrival. The search for a place to record ended on the third floor of a music store, with a borrowed Presto home recorder and the one box of acetates for sale anywhere in town. Nine were used during the only three hours the whole band could get together, and the remaining three took down Johnson's message as a lucky afterthought. Reposing twenty years in a California vault has dimmed their luster not at all, and the transfer to LP shows every sign of care.

Jean Redpath: Love, Lilt, Laughter
Elektra EKL224

Scotland's winsome gift to folk enthusiasts of all ranks and levels presents a bounteous assortment in this second album since her arrival in America. Even a title carefully framed to outline an enticing musical range fails to cover every aspect of Jean Redpath's rich heritage of song. Now busily adding to a repertoire of nearly 400 songs brought over from Scotland, she may eventually record Bluegrass and other quaint styles picked up while wandering on these shores.

As schooled as Miss Redpath is in her national tradition, she never treats older songs as dead relics of the past, and they become heated into living history with the intense flame of her delivery. Tales about weavers, herring fishing, ploughboys, and a story told at a kirk swaree sound timely enough to deal with such current avocations as auto racing and horsebreeding. Also still popular among country folk are old music-hall ditties and dancing to the sole accompaniment of mouth music.

Kid Ory: This Kid's The Greatest!
Good Time Jazz M12045

This set of reissues lists selections from 1953, 1954 and 1956 sessions, and all are prime examples of New Orleans jazz and Kid Ory's tailgate trombone. The eight numbers bearing a 1953 date also recall a bit of audio history, as their appearance marked a new high in fidelity of sound on LP. Many jazz fans were still resisting the changeover from 78s at the time, and the jazz product being put out by most labels was a good reason for replaying older records. About the only microgroove jazz available with superior sound was on E. D. Nunn's Audiophile label, but these releases were mastered at 78 rpm and sold at a premium price. After John Palladino engineered the first of this septet's dates in a Hollywood studio, demonstrations of the original 10-inch LP persuaded quite a few listeners to invest in new equipment. The presence given the horns was remarkable, and the entire rhythm section could be heard in detail on such classics as *Creole Love Call*, *Bucket's Got A Hole In It*, and *The Girls Go Crazy*. Remastering brings the mono sound up to today's standards, and a copy should be in every representative collection.

LETTERS

(*from page 6*)

stereo groove, we would also know the change in depth of the groove. Measuring the distance of the widest (deepest) part of the groove from the narrowest (shallowest) part of the groove, it can be calculated how much recording stylus has moved longitudinally. If we divide the longitudinal displacement of the stylus by the change in depth, we would know the tangent of the vertical recording or modulation angle.

Following this method, measurements were made of recordings produced by the Fairchild cutterhead and CBS test record. Also, the photomicrograph published in AUDIO of the CBS test record was measured. The following results were obtained: The Fairchild cutter had an angle of 17 deg. at 4000 cps (original mechanical design angle of the cutter is 20 deg.)! At the lower frequencies, vertical modulation angle was smaller in the range of 7–10 deg., depending on frequency. This phenomenon could be explained by the fact that the cutter armature flexes at the higher frequencies, shifting the effective pivot point closer to the stylus, thereby increasing vertical modulation angle. The CBS STR111 record was checked and found to have a 14.5-deg. angle, confirming that our method of measuring was adequate. The photomicrograph of the groove was measured and found to be 16.5 deg., again quite close to the reported figure.

As a summary, it can be said that forces reducing vertical modulation angle do exist. More work remains to be done to determine exactly how much effect these forces have at different frequencies and under varying recording conditions (age of lacquer, recording level, stylus heat, and so on). It is well known that most serious problems exist at higher tracing frequencies. At these frequencies pickups would also behave differently, tending to exhibit greater vertical angle.

C. ALEXANDROVICH
Fairchild Recording Equipment Corp.
10-40 45th Ave.
L.I.C., N.Y.

It Takes the Right Equipment

SIR:

Regarding Mr. Harold Lawrence's comments in your March, 1963, issue concerning Diahann Carroll's concert debut at Philharmonic Hall, it should be pointed out that the wireless microphone worn by Miss Carroll is not a part of the "house" sound-amplification system. (*For a listing of "house" equipment see article on page 38.* ED.) Even a high-quality system will suffer if unsuitable input equipment is used or the system not properly operated.

A selection of high-quality *wired* microphones, ultra-directional, cardioid, and omnidirectional, and both dynamic and condenser types, is available for use with the Philharmonic Hall sound-amplification system. Good results depend largely on the use of the proper microphone, selected from those "matched" to the house system, and rehearsal ahead of time for gain setting or use of a special console that can be installed at one of the seats in the hall to permit the operator to hear the sound. Successful results have also been achieved using wireless microphones furnished by CBS Television for use with this system.

DAVID L. KLEPPER
Bolt Beranek and Newman Inc.
50 Moulton St.
Cambridge 38, Mass.

ABOUT MUSIC

Harold Lawrence

Music For Workers, Patients, And Non-People

IN PRIMITIVE SOCIETIES, music performed a functional role in man's daily life. It helped to propagate the tribe, cure disease, protect the harvest, bring on the rain, and fatten the herd. Today, we apply different means to achieve the same ends. Rainmakers take to the air to sprinkle chemicals or drop bombs over cloud formations, agronomists experiment with scientific techniques to accelerate plant growth, and industrial engineers explore new frontiers of automation.

But *plus ça change, plus c'est la même chose.* Music has returned to the worlds of agriculture, medicine, and labor.

Not that contemporary farmers, doctors, and workers perform rain dances, bellow at the sick, or sing throughout the night in front of a vacant house in order to increase productivity among field workers. The modern applications of music are on a more technical, more sophisticated plane.

Song For the Earth

Last year, agronomist George E. Smith in Normal, Illinois conducted experiments to prove that corn subjected to music (or tones) yielded more bushels per acre than corn without sound. He installed audio systems to treat various test plots. The electronic nerve center was located in a barn. From loudspeakers mounted on poles, he directed sound at carefully designated areas. The "programs" ran for twenty-four hours a day, from mid-May to mid-October.

Mr. Smith's experiment got off to a noisy start. The neighbours complained. After the levels had been adjusted in the fields, the corn settled down to the strains of Gershwin's *Rhapsody in Blue,* twist tunes, and random radio music; in addition, there were assorted sine waves. At harvest time, it was found that the highest yield came from the plot that had been bombarded with nothing but a tone of 450 cps; next in output was the mixed-program plot; and lowest in yield, the silent plot. The musical plots averaged in yield between 6 to 10.8 per cent over silent plots.

Will music transform the character of American farming? Hardly likely, declares the University of Illinois College of Agriculture: "No beneficial effects have ever been observed on plants with sounds of any intensity, high or low. In fact, there is no known genetic, biological or physiological reason to believe that sounds can affect plants." The university conceded, however, that sounds of extremely high intensity can damage plant cells. Despite this, Mr. Smith is not discouraged. He intends to carry on with his work for at least another two years.

To Irving Kolodin, music editor of *The Saturday Review,* Smith's corn serenade "had a somewhat familiar ring . . . It was the echo of an experience in New Mexico last summer (1962) at the pueblo of the Santo Domingo Indians near Albuquerque. They were gathered in their annual ceremonial for which visitors come for miles around. Much emphasis in the ceremonial was given over, for hours at a time, to the intense pounding, beating and thrumming of drums, in solo, in pairs and in larger numbers. It could be heard for long distances away, as it went on all through the day of the ceremonial, until the sun went down." It was the annual Corn Dance.

Music To Grow By adds a new wrinkle to agriculture, but farmers already had introduced recordings into the barnyard. From the story of Orpheus and his lute, they calculated that, if music hath powers to soothe the savage breast, it ought to do the same for the tame udder. Cows, it appears, function better at milking time when music is played for them, just as hens produce more eggs to the sound of Schumann and Kreisler.

Music To Work By

The use of music in industry is more widespread: more than 20,000 companies pipe background music into their work areas. At first, recordings were utilized by progressive businessmen for purely humane reasons, to relieve the monotony of production line tasks, and to mute the clatter of industrial noise. At a recent meeting of the Human Factors Society in New York, Stephan Konz, of the department of mechanical and industrial engineering of the University of Illinois, reported that music may also increase production. Konz assigned monotonous manual tasks, such as assem-

COLOR ORGAN

(*from page 26*)

could be used behind a panel, with a rubber idler assembly from another discarded turntable transferring motion between the driving spindle and the second turntable; this arrangement takes up more space, but should not take more than about 10 × 16-in., although the final disc would not be centered in the area. This might have one advantage for a small TV-type screen, if the driving motor was a 3- or 4-speed model, as an extension lever could be added to control the speed from the front panel, and thus the rotational rate could be selected for slow or fast music.

Conceivably, along the variable speed idea of the preceding paragraph, the experimenter might try a d.c. motor geared down and operated from a transformer and rectifier with filter capacitor, connected in parallel with one of the lamp circuits, so that the speed increases as the volume rises, to a maximum. This idea might add an interesting variation, to switch on during some types of music.

Other Modifications and Developments

Interesting effects can be seen when projecting on shiny white drapes because the folds allow some of the colors to be shown in vertical shafts of pure color, shaded from the lamps in other positions. Since the patterns are not very distinct with this method, this might make a good introduction for one or two musical selections, before pulling down the flat white screen to show the varied patterns fully.

In attempting to adjust to different light levels, the human eye changes its iris size, and at low levels this can result in eyestrain unless some light is left in the room, although it should be kept off the screen. A recessed window or alcove, as shown here, is helpful and also limits the spread of the light over the surrounding walls; other experimenters may prefer a wider display, achieving a fan-like shape of changing lights.

This color organ may be built with different types of reflectors and glass objects, such as prisms, broken lumps of cut-glass bowls, magnifying lenses, and so on. Besides a revolving pattern, another possibility is moving a small point-source of light, such as an auto tail light operated from a stepdown transformer (a universal output transformer will do)

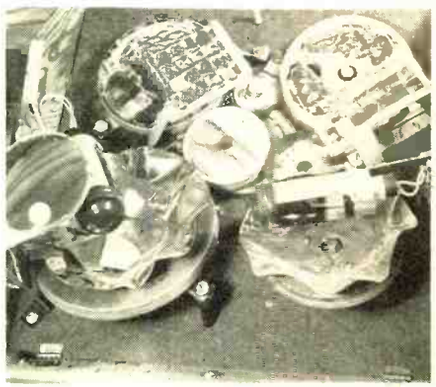

Fig. 19. A front view of the panel containing the clock-motor friction drive shows the rubber-covered wooden disc driving the two left discs directly, and the two at right indirectly through phonomotor assemblies to reverse the direction of these discs.

in a small arc which changes from about an inch to almost in contact with the back of a piece of the multiple-lens glass during perhaps a one-minute cycle; this can be done by mounting the lamp on the end of a three-inch long strip of metal, hinged at one end to a support, riding on an eccentric cam operated by a clock motor, and producing a slowly lengthening set of rays radiating from the glass. In a darkened room the experimenter can try out some of these ideas and any more that come to mind, suggested by materials available, before building them into the machine.

Two more variations are offered for

Fig. 20. One of the directly-driven glass-discs has been removed to show the construction. At the left can be seen the two light openings in one of the dual-lamphouses, through a hole cut in the Masonite panel.

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NEW PRODUCTS

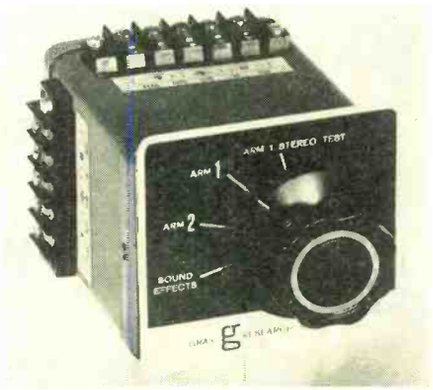
● **Transistorized Stereo Tape Recorder.** Concord Electronics Corporation has introduced its first transistorized 4-track stereo tape recorder. This model, the Concord Model 550, records and plays back 4-track stereo, as well as records sound-on-sound. It features transistorized electronic components. The Model 550 is designed to sell for under $320.00, retail. It weighs 34 lb. Other features include separated 6-inch speakers, dual 10-watt amplifiers, transistorized preamplifiers, and pushbutton

operation. The unit also comes complete with two dynamic microphones, patch cords for recording from radio and hi-fi system, sound-on-sound patch cord, and take-up reel. A special feature is automatic disengagement of the idler wheel when the machine is closed. This prevents damaging the machine by leaving the idler wheel engaged for a long period of time. The Concord Model 550 carries a full year's warranty on all factory parts. Concord Electronics Corp., 809 North Cahuenga Blvd., Los Angeles 38, Calif. **D-1**

● **Shallow-Profile, 8-Inch, Dual-Cone Loudspeaker.** Jensen Manufacturing Co. is introducing a new 8-inch, dual-cone extended-range loudspeaker with a profile depth of only 2 13/16 inches. It is designed specifically for high-quality, trouble-free, commercial-sound installations. The Type

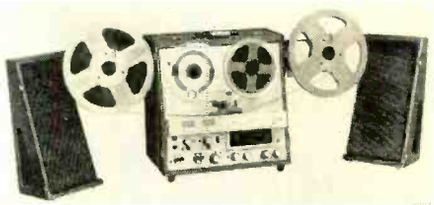
C-835 two-element loudspeaker, newest addition to the Jensen Professional Series Line, is intended for applications where good music quality and speech intelligibility are demanded, but with more modest loudspeaker cost. Schoolrooms, offices, restaurants, stores, and other similar installations are typical examples. It can also be used for time, warning, and alarm signals. The new loudspeaker, with its supplementry apex radiating element, is integrated with the primary radiating diaphragm (cone) and driving coil to achieve added frequency range with improved angular coverage in the upper frequencies of speech and music. Higher efficiency and sensitivity is further assured through the use of a new Syntox-6™ ceramic magnet. The C-385 is also available to the professional sound contractor and distributor in convenient 10-pack cartons that can be delivered to the job location in one lot or can be used individually; optional 70.7 or 25-volt factory installed transformers, and KWIKON instant connectors for input and power tap adjustment. Performance specifications: power rating is 10 watts; response range is 35–18,000 cps; 95-deg. coverage angle; sound pressure level is 84 db at 10 ft. for 1 watt input. The type C-385 has a nominal impedance of 8 ohms; a resonant frequency of 70 cps; O.D. is 8⅛-inch by 2 13/16-inch deep; four mounting holes at 90-deg. on a 3 13/16-inch radius; net weight is 1-lb. 10 oz. Complete architect and contractor specifications and detailed electrical-mechanical characteristics can be obtained on request from Commercial Sound Products Dept., Jensen Manufacturing Company, 6601 S. Laramie Ave., Chicago 38, Ill. **D-2**

● **Broadcast Tone Arm Switch.** A new multi-purpose low-level audio control that permits smooth switching between two mono or stereo tone arms, and enables untrained personnel to check out a stereo system, is now available from Gray Research and Development Co. Called the 404 Tone Arm Switch, this latest in a line of audio products designed for the broadcast industry by Gray Research, offers a wide range of features and advantages not available to station engineers before. The basic function of the new 404 Tone Arm Switch is to connect two tone arms to either a mono or stereo equalizer and permit the operator to shift from one arm to the other as needed in playing various types of records. The switch is also designed so that in case of a malfunction in



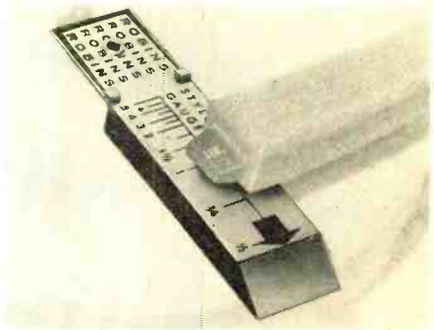
the stereo system, non-technical people can check out the system quickly and accurately. As an additional advantage in record-cutting operations, the 404 provides groove noise information for adjusting and controlling heat on the stylus. By interconnecting two tone arms, the 404 also permits the production of continuous sound effects and can automatically provide vertical output for cartridges used on hill and dale transcriptions. The 404 can be connected to the Gray 602-C Equalizer, the 604-M/S Equalizer recently introduced, or most equalizers produced by other manufacturers. The 404 Tone Arm Switch is priced at $37.05. Additional information may be obtained by writing to Gray Research and Development Co., Box 12, Elmwood Conn. **D-3**

● **Tape Recorder.** Bell Sound has just introduced the RT-360 "Professional" tape recorder. Although the RT-360 provides several desirable features, its outstanding claim is its tape duplicating capability. A unique head arrangement and accessory reel adaptors permits duplication of tapes on the one machine. The RT-360 utilizes the well-known mechanism of the Bell T-337 and T-347 decks, with three-motor drive and electro-dynamic braking. Electronically, the RT-360 contains a 16-watt stereo amplifier. Twin speakers are housed in folding, removable baffles, which form the cover of the case. When these are folded back against the main part of the case, ports in the speaker housing match others in the case, thus adding to the size of the baffle housing. Eight-foot cords are supplied, so that the speakers may be removed and placed widely apart for good stereo separation. Accessory motorized



adaptors (shown) permit use of any size reel up to 10½-in. to extend the playing time capacity of the machine up to six hours in stereo or 12 hours in ¼-track mono at 3¾ ips. The adaptors are also used in the duplicating function. The RT-360 is contained in a rugged carrying case, but it may be custom installed. In such installations, it can operate either horizontally or vertically. The RT-360 can be used as a public address system and record speech simultaneously; or it can be used as a musical instrument amplifier, again permitting simultaneous recording of the performance. The duplicating feature has a wide variety of applications. The RT-360 will duplicate a stereo tape or convert it to mono tape. It is now in production and will be available at the retail level around May 1. Bell Sound Div., Thompson Ramo Wooldridge, 6325 Huntley Road, Columbus, Ohio. **D-4**

● **Stylus Gauge.** A new, easy-to-use stylus gauge which measures the tracking force of any stylus and cartridge assembly from 8 grams down to ½ gram, is now available. This accurate gauge, Model SG-2, calibrated in ½-gram increments, works on a balance principle with counter-balance weights permanently in place. To determine if a cartridge and stylus are tracking at the force recommended for



best performance, the user places his stylus on the gauge and moves it until the platform is level with the base of the gauge. He can then make the necessary adjustments to reduce or increase the tracking force. The plate on which the stylus rests is made of soft brass. This material was chosen for maximum protection of the stylus. List price of the SG-2 is $1.45. Robins Industries Corporation, Flushing 56, N. Y. **D-5**

bling and disassembling washers, or putting nuts on bolts, to groups of students. The tests revealed that output rose 17 per cent when music was played.

Music for Machines

Even nuts and bolts now have their own musical programs of a sort. A firm recently brought out a machine cleaner that operates by sound. Metal parts to be cleaned are placed in a water tank through which high-frequency tones are transmitted. The dirt miraculously drops off. At a recent demonstration in New York's Coliseum, the company's representative invited spectators to dip their fingers into the tank while the machine was in operation. The effect was like a sand-papered electrical shock. If left in the tank for more than a minute or two at higher sound levels, the flesh would disintegrate under the bombarding high frequency waves.

New industrial applications of sound are cropping up each year. For example, sound waves are now employed to jiggle wet cement, a function previously performed by mechanical vibrators.

Dental Ditties

In the field of medicine, doctors have found that music relieves the tension of the waiting room. A physician in Atlanta has even brought music into the operating room to calm patients undergoing surgery with local anesthetics. About one year and a half ago, dentists began using a special musical device for skittish patients. It was a box with earphones attached. The patient wore the "cans," which relayed two programs from a tape machine. The first contained soothing music with no sudden dynamic changes; the other transmitted "white sound," resembling a waterfall or fountain. The patient controlled the programs himself by means of two dials located on the box. The music was designed to mask the sounds of the drill and the sharp-pronged explorers; the "white sound," a sort of aural poultice, was meant only to counteract intense pain. Production of audio analgesics, however, has been discontinued. Some dentists talked darkly of possible damage to brain cells caused by the over-use of "white sound." But the earphones and the "dry" music have remained.

Walt Whitman wrote:

I hear America singing, the varied carols I hear, those of mechanics, each one singing his as it should be blithe and strong. . . .

Today, the great rhapsodic poet would be hearing America not only sing, but hum, squeal, buzz, and drone. And, before long, perhaps only Death Valley and Pike's Peak will be safe from the sound-carrying agronomists, physicians, engineers, and background-music vendors. Æ

those who want to experiment further—a set of low-priced or used 35-mm slide projectors can be fitted with color filters and their lamps connected to the color amplifier enabling some or all of the patterns to be shown from a longer distance upon a standard glass-beaded screen. In place of slides, thin discs of rippled glass, or clear plastic with patterns photographed or painted on them could be rotated in the focal plane of the projection lenses; operated by small clock motors and positioned so that the segment of each disc projected seems to rotate in a different direction, the resultant patterns would blend colors where the bright sections overlapped on the screen, while an individual color streak would appear in full intensity where it happened to be projected in the darkened section of the other patterns. With the amplifier shown, the lamps would have to be limited to a maximum of 100 watts each.

Another experiment tried was to project on the screen a film consisting of highlights of ocean waves edited roughly to recorded music while the color organ projected varying color patterns in the darker parts of the pictures, with often pleasing effects. Using a rheostat dimmer or Variac on the projector lamp, fading-in color or black-and-white slides during the performance of a selected and appropriate series of scenes offers some imaginative possibilities for a presentation suited to a larger group, although this detracts from both the realistic scenes and the purely abstract qualities of the color organ, but undoubtedly some of the results would be pleasing to many people.

A word might be inserted as to the best kinds of music to present on the color organ—any kind will give an interesting effect, but some kinds are especially fascinating, notably those with definitely separated frequencies at different times. In the classical field, some of the music of Stravinsky and Bartok, among many others, proved interesting; some of the newer novelty instrumental albums, such as the popular Taboo, are very good visually, and although I am not acquainted with the subject, the instrumental effects of some kinds of jazz music would seem to offer possibilities. Experimentation is the best way to discover what looks best, varying the volume and decay settings.

Undoubtedly the future use of the color organ will still have limited appeal to the population as a whole, which seems to prefer the shoot-em-up and gal-kissing type of realism, but for those with a different esthetic interest, or for those merely seeking a visual novelty, some form of abstract color rendition seems to offer possibilities in artistic exploration and electronic experimentation. AE

MODIFIED AV-1

(*from page 44*)

read just like the copy. The photo-engraving process consists of printing a negative onto a sensitized copper (or zinc) plate, treating the printed copper so that where light hit the sensitized surface it becomes resistant to the etch, and then etching away the remaining metal. Actually there is rather more to it than that, but the making of printed-circuit panels is much simpler, and as soon as the copper is etched off the panel, the job is complete. After thorough washing, the holes are drilled, using a #55 drill for the separate soldering points, and larger drills where indicated. The components are placed on the opposite side of the panel from the printed circuit, the leads bent over, and soldered. It is recommended that the leads to the transistors and diodes be "heat-sinked" during soldering, using a special tool for the purpose such as an X-acto Lock-Grip plier or, more simply, the tips of a long-nosed plier. Hold the lead firmly on the opposide side of the panel from the soldering, and continue to hold the lead until the soldered joint is cool. Then proceed to the next lead, making certain that the tool has not heated up appreciably. Transistors and diodes can be ruined if improper soldering practice is followed, and at $17.60 for the five transistors, it is better to be slow than sorry.

Calibration

Once the instrument is completed, the calibration procedure is similar to that outlined in the Schotz article. The first step is to adjust R_{18} to obtain 4 volts d.c. the emitter of Q_5. It will be necessary to connect *some* 3000-ohm resistor from Sw_1 to ground in order to make any preliminary adjustment. The exact value is not important, since it will be determined in the calibration process. Assuming that a second a.f. voltmeter is not available, it will be necessary to obtain some known voltage source for calibration. The usual 117-volt a.c. line comes close enough, if no other source is available.

Using three more of the resistors from the original AV-1 switch connected as shown in *Fig.* 5 will give 0.88 volts at the junction of the three resistors. Apply this voltage to the input terminals with the selector switch set at 1.0 volts and adjust R_{17} to obtain an indication of 0.88 on the 1-volt scale. Then with the selector switch set on 300 volts, apply the 117-volt line signal to the input terminals and select a 10-per-cent 3000-ohm resistor which will give a 117-volt indication on the 300-volt scale. Remember to switch the 117-volt line off

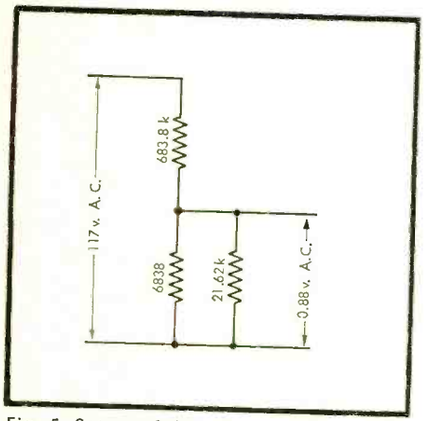


Fig. 5. Set-up of three resistors from original selector switch to provide a low voltage for calibration which is related to the 117-volt a.c. line.

each time you change the 3000-ohm resistor. While this method is admittedly a "quick and dirty" one, it will give accuracy within about 5 per cent in most instances.

One other method of achieving the same result is to use a 3300-ohm 5-percent resistor and connect it permanently in place. Then try a number of different 100-k resistors across the 3300 ohms to make the correct calibration.

If another a.f. voltmeter is available, simply apply a signal of, say, 10 volts to the top of Sw_1 and note the indication on both instruments. Then reduce the applied signal by 50 db, as measured by the second instrument, and adjust the value of R_1 by substitution so that the output of the transistorized meter indicates the same value. Any of these methods will give approximately correct results—the latter being the best, obviously.

Using the A.F. Voltmeter

Because of the high input impedance of this type of a.f. voltmeter, it is possible to use it to measure signals practically anywhere in an electronic circuit, just as it is possible to measure d.c. voltages with a v.t.v.m. of the usual type at tube elements where an ordinary voltmeter—even one having a resistance of 20,000 ohms per volt—would load up the circuit and give indications which were not truly representative of actual operating conditions. With a little experience, it is possible to make a large number of measurements with an a.f. voltmeter of high input impedance. A few such measurements are described in the following paragraphs.

Gain. Figure 6 shows a typical set-up for measuring voltage gain in an amplifier. A signal is fed to the input and the amplifier is terminated in its nominal load, either with a resistance or with a loudspeaker, for example. In (A) is shown the method using two a.f. voltmeters, while (B) shows the same type of measurement using only one instrument. The output signal is measured first to make sure that the amplifier is not being operated at an output level greater than its rating. Output power can be calculated when load and signal are both known, and is given by the formula

$$P = E^2/R$$

where P = power in watts
E = measured signal voltage
R = load resistance.

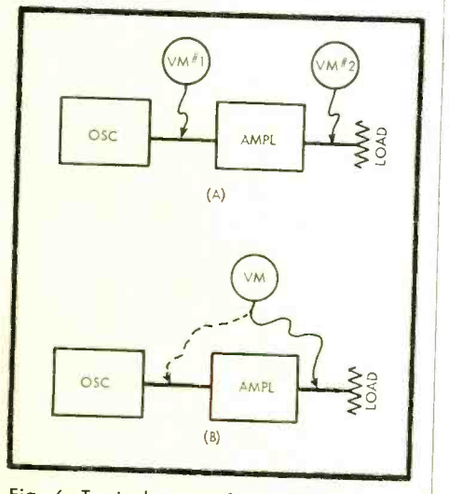
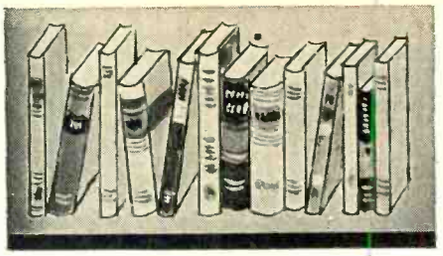
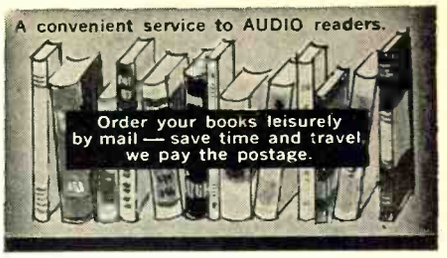


Fig. 6. Typical set-up for measuring amplifer gain.





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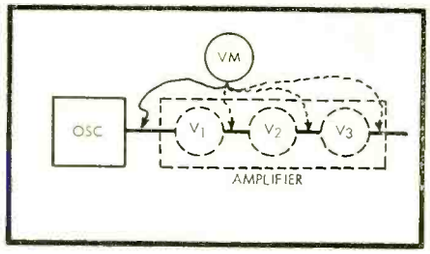

Fig. 7. Method of measuring individual stage gains in an amplifier.

The voltage gain of the amplifier is simply the ratio of the output to the input voltages. The gain in db is calculated from the formula

$$Gain\ (db) = 20 \log\ (E_o/E_i)$$

where E_o and E_i are output and input signal voltages respectively. This formula is strictly true only when the input and output impedances are equal, but the gain in db is often expressed without correction for differing impedances.

Figure 7 shows how the gains for each of several successive stages may be measured. This type of information is often useful in design work, and more practically, in servicing. Gains over triode stages are likely to range from 10 to 40, and over pentode stages from possibly 25 to 150. The average gain figure encountered from grid to plate of a pentode or tetrode output stage is of the order of 17.5, and any measured value differing from that figure appreciably should be sufficient cause to suspect the stage.

Feedback. The amount of feedback may be determined by measuring the input signal required for a given output with the feedback network connected, and then measuring the input signal required with the network disconnected. The amount of feedback, in db, is given from the formula

$$Feedback\ (db) = 20 \log\ (E_1/E_2)$$

where E_1 is the input signal with feedback and E_2 is the input signal without feedback.

Harmonic Distortion. Figure 8 shows a simple method of determining harmonic distortion. The output of the amplifier under test is fed into its nominal load, followed by a bridged-T null circuit which is terminated with a resistive load. With a simple circuit of this type, the exact null frequency may not be known accurately, so the procedure is to adjust the oscillator to obtain a minimum indication in the meter at position B. As the frequency is approached, the shunt resistor R is varied. When further changes in oscillator frequency and the value of R result in no further reduction in the indication of the meter in position B, the meter is shifted to position A and the level adjusted to that at which the distortion

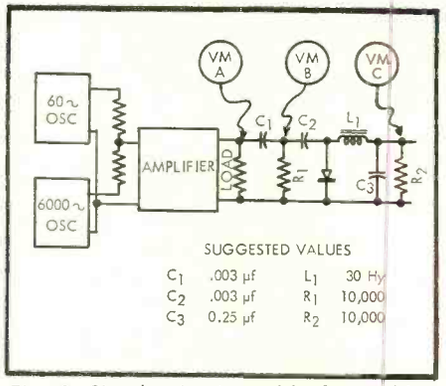

Fig. 8. Simple circuit usable for making measurements of harmonic distortion.

measurement is to be made. Then shift the meter to position B again, make any further adjustments of the oscillator frequency and the value of R to obtain a minimum again. The distortion is then given by the formula

$$D = (E_B/E_A) \times 100$$

where the signal voltages E_A and E_B are those read on the meter at the corresponding positions.

The values of the inductance, the two capacitors, and the resistor will depend on the frequency at which the distortion measurement is to be made. A suggested value for L is 8.0 Henry; C_1 and C_2 should then be approximately .04 μf for 400 cps, .006 μf for 5000 cps, and .00025 μf for 5000 cps. R depends on the Q of the inductance, but should be a variable having a range from zero to, say, 500,000 ohms.

Intermodulation Distortion. A simple IM distortion measurement circuit can be arranged as shown in *Fig.* 9. This circuit will not yield quantitative measurements but is useful in experimental development work to give qualitative figures.

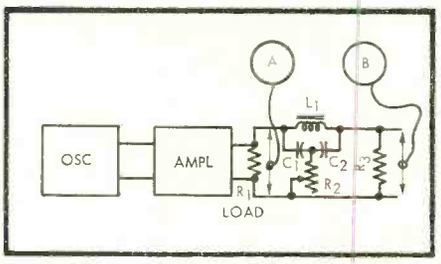

Fig. 9. Suggested arrangement of circuit for intermodulation distortion measurements. While not near laboratory accuracy, this method will give comparative figures.

An input signal consisting of 60 cps and 6000 cps mixed together, with the level of the 60-cps signal being four times that of the 6000-cps signal, is used for the measurement. The amplifier to be measured is terminated with a resistor equal in value to the nominal output impedance of the amplifier. This is followed by a network consisting of a high-pass filter, a rectifier diode, and

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a low-pass filter. The high-pass filter is simple, since it has only to separate 6000 cps from 60 cps, and thus consists of a small capacitor followed by a resistor. A second capacitor couples the resulting high frequency to the diode, which rectifies the signal and leaves only the modulation of the 6000-cps frequency. This is passed through a low-pass filter consisting of L_1 and C_3, and terminated with R_3.

The measuring procedure is as follows: Adjust the input signal to obtain a desired output level across the load R_1, as determined by measurement of the voltage across the load. Shift the a.f. voltmeter leads to position B and note the level of the signal. Call this Value E_B. Then shift the meter leads to position C and again measure the signal level, calling this value E_C. The IM distortion is then given by the formula

$$IM\ (\%) = (E_C/E_B) \times 100.$$

Typical readings taken on an amplifier might be $E_1 = 20$ volts (the power across a load of 16 ohms this would be $20^2/16$, or 25 watts); $E_B = 5$ volts; and $E_C = .08$ volts. IM is then $(.08/5) \times 100$, or 1.6 per cent. The indicated distortion is likely to be somewhat larger than when measured on standard IM equipment, but for comparative measurements —using the same equipment throughout —the results can be of some value in maintenance work.

Conclusion

The a.f. voltmeter is one of the most valuable instruments in the hands of the audio technician, and with a full knowledge of its capabilities it is able to provide a large amount of valuable information about performance of audio equipment. It is possible to measure the output of phonograph pickups directly, using a frequency record; it is possible to check the equalization curves of amplifiers or networks; it is useful in making distortion measurements; in short, it is the second most valuable tool of the audio technician or experimenter —the first place belongs to the volt-ohm-milliammeter, either of conventional or of vacuum-tube circuitry. And it is quite likely that transistorized versions of the electronic voltmeter will soon be readily available.

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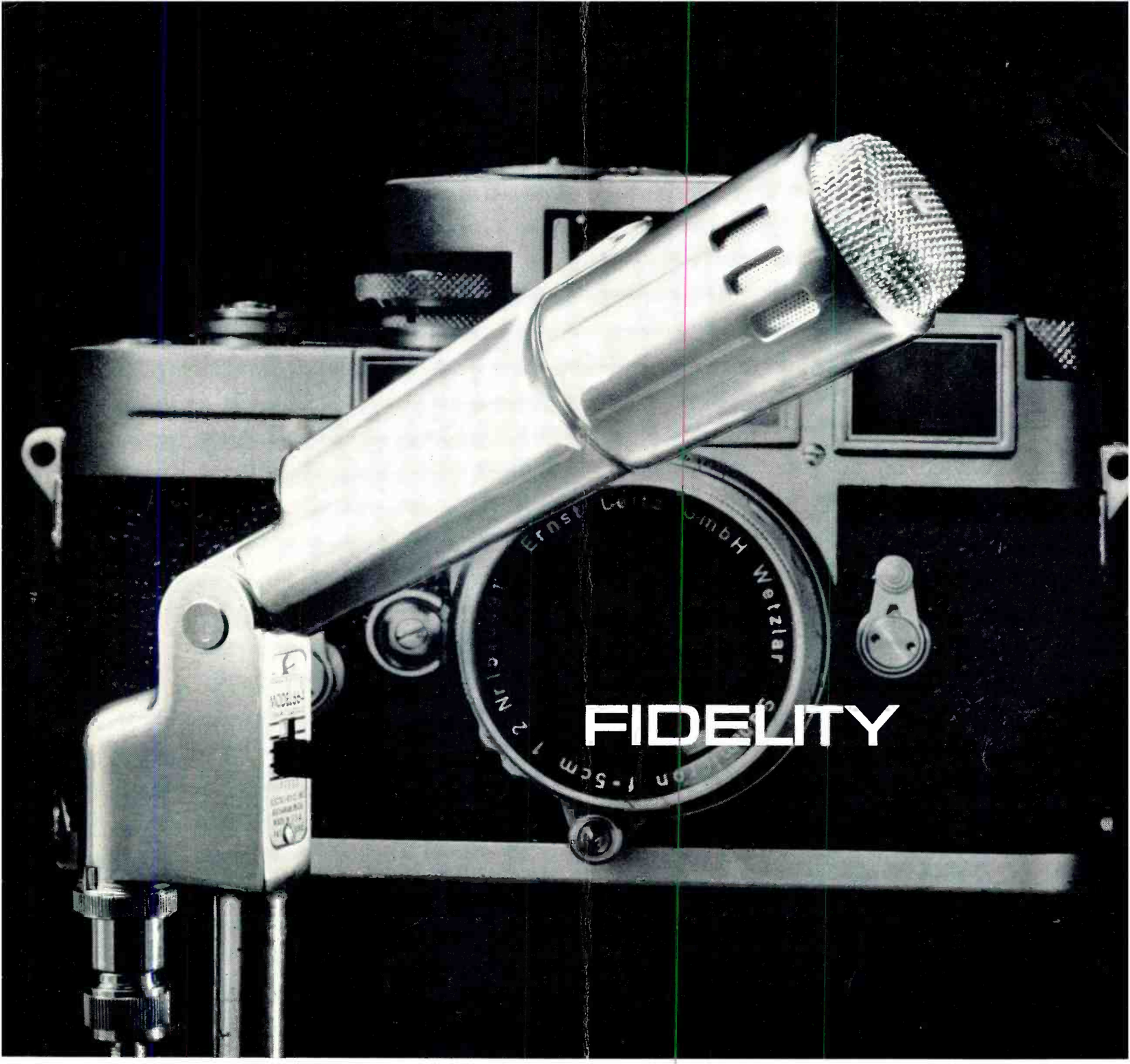

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